May 18, 1929 | A McGraw-Hill Publication | 20 Cents per Copy

AVIATION

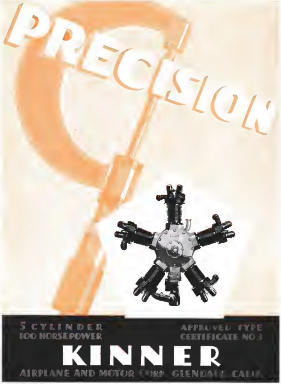
The Oldest American Aeronautical Magazine

SPECIAL FEATURES

THE *Fleet* BIPLANE (MODELS 1 AND 2)

Motor Truck ADVERTISING VS. *Airplane* ADVERTISING

THE *Series C* "WASP" ENGINE



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Eminent leadership . . . performance that justifies confidence . . . airworthiness par excellence. Mohawk is writing a new page in aviation history . . . open cockpit and cabin ships of unique design and construction . . . training ships, commercial planes and individual sportsters of the air. If you are keeping pace with aviation, you should know about them . . . complete information and specifications upon request . . . write for them at once.

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NEW "Van Dorn" ELECTRIC VALVE REFACER

VR-700

$160.00

Capacity $^5/_{16}$" to $^7/_8$" Valve Stems

THE new Van Dorn Electric Valve Refacer has been designed to accurately reface poppet valves, and in addition, sharpen valve seat cutters, grind rocker arms, dress valve seat hones, etc.

It is driven by a constant speed motor which insures against irregularities in grinding due to changing speed.

The valve is chucked in the machine by means of a Van Dorn "Twin Grip" collet and in the case of valves with stems of short length, special collets are available.

The "Van Dorn" Electric Tool Co.
Cleveland, Ohio.

S P A R T A N

The New Spartan C-3 Challenger

The early standards of Spartan airplanes have now proven themselves the most effective sales arguments and have resulted in enthusiastic owner satisfaction, expanding and spreading the reputation of Spartan as a builder of advanced aircraft.

Spartans are exact in construction, precise in maneuverability, dependable in performance and built to endure They are suited to the strenuous demands of commerce, the regular business expedition or the casual pleasure hop. Beauty is obtained by correct design

The new Spartan C-3 Challenger is rugged but not heavy, and is easily landed with or without power. Qualities of balance and distribution of surface are so thoroughly accurate that flight in the Spartan is natural and does not involve "fighting the stick."

Special equipment which is standard on the Spartan C-3 Challenger includes dual controls, booster magneto, air speed indicator, Oleo gear, 10 by 3 tail wheel with inflated tire, 30 by 5 Bendix wheels and brakes, adjustable stabilizer and Hamilton steel propeller

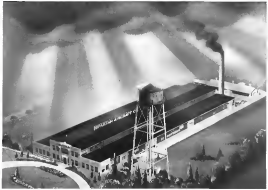
An attractive folder giving full details will be sent on request.

Details and specifications of the Spartan powered by the 130 h. p. Improved Walter Motor will be furnished on request.

The New Spartan C-3 Challenger is powered by the Curtiss-Challenger 170 h. p. radial air-cooled motor

SPARTAN AIRCRAFT COMPANY
TULSA - - OKLAHOMA

DEDICATED TO SAFE AIRCRAFT CONSTRUCTION



AND GEARED TO A STANDARD OF OWNER SATISFACTION

Spartan C-3 Challenger

Spartan C-3 Walter

In the production of aircraft the first requirement is the best that can be had in facilities. These include a factory efficiently laid out and organized, the best mechanical equipment that science can supply, the most highly skilled labor obtainable.

The rest depends upon the attitude of the institution.

In the Spartan organization, there is a sense of conscientious obligation to the Spartan buyer. Exacting standards are maintained; each part is subjected to rigid inspections and tests; each assembled unit is judged by inflexible requirements. The constant aim is for final perfection rather than speed of manufacture.

There has never been a Spartan structural failure.

SPARTAN AIRCRAFT COMPANY

Tulsa, Oklahoma.

★*ACHIEVEMENT (Noun) A noteworthy and successful action or a distinguished feat. An escutcheon.* *(Heraldry)*

WHERE 300 h. p. MEANS 155 m. p. h.!

A *New* Whirlwind-Vega by Lockheed Aircraft Company

Horse Power for Horse Power
Lockheed Defies Competition!

Open its throttle wide and experience the *thrill* of 155 honest miles per hour! Nose it up and get the *feel* of 1250 feet per minute climb! Cruise all day at 130 m.p.h. Such is the incomparable performance of this newest Whirlwind-Vega powered with Wright J-6, 300 h. p. engine. * * In design and construction as well as in performance and breaking records—*it takes a* Lockheed *to beat* a Lockheed!

Feel secure in the knowledge that every Lockheed is the *super-inspected* product of a highly skilled organization, and that behind the brilliant performance and tremendous speed of Lockheeds are safety factors far in excess of all legitimate requirements. * With a full realization of responsibility to those who fly, only selected craftsmen of *proven* skill are employed in the construction of Lockheed Aircraft.

Lockheed Monoplanes are fully equipped, including electric self-starter.

LOCKHEED AIRCRAFT COMPANY . . . Los Angeles, U. S. A.

LOCKHEED

KEEPING THE MAILS MOVING

ELIMINATE faulty lubrication and you do away with an important cause of engine failure. On many miles of airways -TP- Aero Motor Lubricating Oil keeps the engines running smoothly—helps to deliver the mails on time.

-TP- Oils are new—the latest development in scientific lubrication. They have been tested and approved by leading manufacturers of airplane engines and by many leading pilots. They are straight-run oils, not blended or compounded, produced from pure, paraffine-base crude by a process for which patents are pending.

This process has marked advantages over other methods. It removes all the paraffine wax, while preserving all the lubricating bodies in the crude. Elimination of the wax is responsible for its low cold test.

In terms of performance this means uniform viscosity at all working temperatures, minimum carbon deposit and ignition trouble from fouled spark plugs, easy cold priming, immediate oil pressure, perfect lubrication winter and summer, on the ground or at high altitudes—a maximum of safe flying hours.

A handsome, practical *Pilot's Log Book* sent free on request. Please use the coupon.

-TP- Aero Rocker Arm Lubricant

A pure, paraffine-base, low-cold test, mineral-oil lubricant. Free flowing—will not carbonize. Send 50c for 1-pint trial can.

TEXAS PACIFIC COAL AND OIL COMPANY
FORT WORTH, TEXAS
New York St. Louis Los Angeles

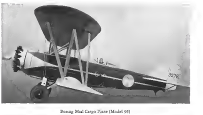
-TP- AERO MOTOR LUBRICATING OIL
PATENT PENDING

Aviation 5-18 29

Texas Pacific Coal and Oil Company, Fort Worth, Texas
Please send me, without obligation, your Pilot's Log Book.

Name.. Address..

Your Oil Dealer's Name..



Boeing Mail Cargo Plane (Model 95)

National Air Transport, Western Air Express *and* Robertson Aircraft —buy *Boeing Planes*

SPECIFICATIONS:
(Model 95)
Approved Type Certificate No 106
Engine—Pratt & Whitney "Hornet" 525 hp

PERFORMANCE
(With 1 610 Pounds Pay Load)

High Speed (Propeller Setting, 16°)	140 mph
High Speed (Propeller Setting, 17°)	142 mph
Landing Speed	56 mph
Rate of Climb (ft. per minute)	950 feet
Climb in 10 minutes	7 350 feet
Time to 10,000 feet	15 4 minutes
Service Ceiling	16,000 feet
Take-off Run	540 feet
Take-off Time	11 6 seconds
Wing Loading	11 02 lbs/sq ft
Power Loading	11 1 lbs/hp

DIMENSIONS

Span	44 feet 3 inches
Length overall	31 feet 11 inches
Height overall	12 feet 1 inch

WEIGHTS

Empty	3 196 pounds
Pilot	170 pounds
Fuel (130 gallons)	767 pounds
Oil (12 5 gallons)	97 pounds
Actual Pay Load	1 610 pounds
Gross Weight Loaded	5 840 pounds

SIXTY days ago the Boeing Airplane Company announced it had mail planes for sale It said the new Boeing Model 95 is the fastest, heavy payload, most economical, single engine mail-cargo plane made

Within the last month Boeing mail planes have been delivered to National Air Transport, Western Air Express and Robertson Aircraft Corporation. *These pioneer air companies, with a total of millions of miles of flying behind them, had the airplane field to choose from when purchasing new equipment.*

Model 95 is the plane that "3⅓ *million miles of flying developed*" It is adapted for any route in the country because the Boeing System had to build a plane for its own use which would operate equally well at sea level or 12,000 feet, at sub-zero or tropical temperatures. A plane Boeing System can use on its routes must have speed, heavy payload (1,610 pounds), quick take-off, low landing speed and economical operation. It must minimize night flying difficulties, have rapid servicing features, and be so planned as to obtain maximum loading of the payload.

National Air Transport, Western Air Express and Robertson Aircraft Corporation recognized the advantages Boeing equipment offers to operators seeking carriers with outstanding performance—dependable, economical, revenue producing—"on the job every day"

Due to superior performance over any other large capacity, high speed carriers, Boeing mail planes are now used on five of the pioneer air mail routes in the country—a merited indorsement.

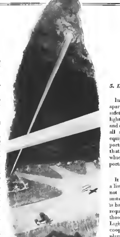
Model 95 is offered for immediate delivery.
Models 40B and C—mail and passenger—and Model 204—flying boat with six seats—offered for ninety day delivery.

Boeing Airplane Company

(Division of United Aircraft and Transport Corporation)

Seattle, Washington

What, finally, determines good Airport Lighting?



By E. J. DAILEY
Lighting Sales Manager
Graybar Electric Company

This is Number 2 of a series of advertisements whose purpose it is to reduce the information on airport lighting to its simplest terms.

1. What "sums up" the ideally lighted field?

It is as easy to find, as easy to identify, as easy to land upon, by night as by day.

2. By what standard is Airport Lighting measured?

The Department of Commerce has set up definite standards of airport lighting. Any field which earns an "A" rating must of necessity be well lighted.

3. What, generally, must be provided for an "A" rating?

Seven things: An airport beacon. Boundary lights. Obstruction lights Hangar floodlighting Field floodlighting An illuminated wind direction indicator. A ceiling finder And of course personnel to operate it

4. What, briefly, does this equipment accomplish?

It locates and identifies the field to the incoming pilot. It reveals the "plan" of the field to him It guides him *away* from obstructions and poor approaches and *to* the runways. It gives him a measure for judging distance. It gives him "daylight" on the field It gives him obvious aids to navigation

5. Does all this justify itself, commercially?

In a purely commercial sense, apart from any considerations of safety, an investment in airport lighting should justify itself over and over again. In the near future all airports will be adequately equipped In the meantime, airports that are well lighted have that all-essential early "edge" which may have far deeper importance later

* * *

It should be noted, finally, that a list of approved equipment does not make an approved lighting installation Correct application is based on the highly individual requirements of a given field To those interested, Graybar's Airport Lighting Department offers its cooperation and experience in planning and recommending field equipment As a starter, there is a coupon below

Offices in 72 principal cities

GRAYBAR ELECTRIC CO
Graybar Bldg. New York N Y
Gentlemen
Please send us more information on Airport Lighting.
Name
Address
Av 2

THE GRAYBAR TAG—SYMBOL OF DISTRIBUTION

GraybaR
Successor to *Western Electric* Supply Dept.

AIRPORT · LIGHTING


GOOD
Look to Goodyear!
"*Let's ask Goodyear*" says the designer, and mails the blue prints. "Put it up to Goodyear," says the builder, and sends the pattern. "*Goodyear will give us the answer*," says the pilot, and calls for tire data
No matter what the question, if it pertains to airplanes and *rubber*, look to Goodyear for the answer. The correct answer.
Goodyear's veteran and skilled aeronautics department is at the service of aviation. Any problem you present gets immediate sympathetic attention from a corps of experts who have grown up with the airplane. Simply write, wire, telephone, or come personally.
Aeronautics Department
GOODYEAR, AKRON, OHIO
OR LOS ANGELES, CALIFORNIA
EVERYTHING IN RUBBER FOR THE AIRPLANE


Scarab
A RECORD to SHOOT AT
A Warner Scarab equipped Cessna flying from Wichita, Kansas, to Curtiss Field, Long Island, traveled a total of 1325 miles in 11 hours and 50 minutes (making one stop at St Louis), on 64 gallons of gasoline
This is an average of 112 miles per hour and better than 21 miles per gallon of gas
In both air races and in regular commercial work the Warner Scarab is establishing remarkable records for reliability and economy
MONOPLANES CESSNA
THE CESSNA AIRCRAFT COMPANY
WICHITA
April 6, 1929
The Warner Aircraft Corp.
Detroit, Michigan
Gentlemen:
CVC*C
Yours very truly,
Economy
Only 1-2/3 Cents per Mile
WARNER "Scarab" ENGINES
WARNER AIRCRAFT CORP.—DETROIT, MICH.

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The Oldest American Aeronautical Magazine

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AVIATION

THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

May 18, 1929

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Industry vs. Government

IT IS BEGINNING to be realized that the act of Congress authorizing the granting of licenses to planes and pilots was virtually a declaration of perpetual warfare between the Department of Commerce and the aeronautical industry It is almost a religious war that is being fought, for both sides claim to be working for the benefit of aviation. The method of salvation is different, the Government claiming that it can be accomplished only by regulation, and the industry claiming that it can be accomplished by freedom in the progress of design The Government tendency, as evinced by the increasing scope and detail of the regulations, is toward complete control of the design requirements of planes, whereas the industry claims that such regulation as there is should come from the industry itself

These are fundamentally different views and can never be completely reconciled A never ending warfare has been started between two opposing principals This fact might just as well be acknowledged, for then the rules of warfare can be drawn up and the belligerents will feel less bitterly toward each other The situation which led to the Detroit conferences between the Department and the industry should make both parties realize that there is a fundamental difference in the methods by which they hope to achieve greater safety in aircraft The differences must be fought out between the heads of the government department and the executives of the various companies The details to be discussed will often be highly technical but the decisions will usually be too important to be decided solely by men who are absorbed in purely engineering problems

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Airport Garages

THERE ARE, as a rule, more automobiles at an airport than there are airplanes. Some belong to employees, some to visitors and others to plane owners or to those who are making a trip over an airline and expect to return to the airport This latter class often will desire to leave their cars at the airport while they are away, but they will not want to leave them where they will get covered with dust and out in the open where they may be tampered with during the night Garage facilities should prove to be an added source of ravenue for the flying fields and as the number of private plane owners increases they will prove to be almost a necessity

//

Deserved Recognition

THE AMERICAN aircraft industry is divided, in one sense, into three classes—the sheep, the wolves, and the constructive body of the industry

Perhaps the sheep's class will always exist in every branch of human activity In aviation this group contributes little to general progress and devotes too much activity to a hurried copy of something which some one else is doing For example, two years ago the three-place open biplane was popular and many designers attempted to develop an airplane of this sort Now the three-place closed monoplane has gained public favor and this type is being developed on a wide scale Such wholesale copying of one another is a vast economic waste and a real detriment to the industry

The aviation wolves are in attitude, more deplorable than in actual action They are the ones who think it is necessary to either gobble up the other fellow or be gobbled up, and who believe that a good way to advance one's own interest is to knock that which is done by someone else. Obviously this sort of dog-eat-dog competition cannot contribute to the lasting progress of aviation

Fortunately the industry also includes a constructive group which is proceeding as rapidly as possible to develop new things—new engineering features, new sales methods, new air services. Those people who have something to offer to the public or something to contribute to aviation progress are happily in a majority and are the ones who are the real builders

There is no room in the aviation industry for sheep and wolves With so many real problems to solve we must give all recognition and every assistance to the men who mind their own business and work for progress

THE *Fleet* BIPLANE

(MODELS 1 AND 2)

By Leslie E. Neville

THE FLEET BIPLANE, which is at present manufactured by the Consolidated Aircraft Corp Buffalo, N Y for Fleet Aircraft, Inc , is a two place single bay type having seats in tandem in a single cockpit cutout, and designed for engines in the 60-150 hp range of radial air cooled types It was intended originally for the seven-cylinder Warner "Scarab" engine which develops 110 hp at 1,850 r p m and more recently has been offered with the five-cylinder Kinner K-5 power plant which is rated 100 hp at 1 850 r p m The Scarab powered plane is designated Fleet Model 1 and the Kinner powered craft, Model 2 Other installations will be offered when thoroughly tested

The Model 2 has a high speed (sea level) of 113 5 m p h at 1 900 r p m , a minimum speed of flight of 40 m p h , a rate of climb at the ground (full load) of 930 ft per min and a ceiling of 16,000 ft. The high speed of the Model 1 is 111 m p h

The weight of the Model 1 empty with wooden propeller and without starter, is 976 lb The disposable load is 554 lb and the gross weight is 1,530 lb The weight of the Model 2 empty, with metal propeller and starter, is 1,022 lb disposable load 560 lb and gross weight 1,582 lb Model 1 is manufactured under approved type certificate No 122 and Model 2 under approved type certificate No 131

The plane has a wing span of 28 ft a length of 20 ft 9 in The height of the Fleet Biplane is 7 ft 10 in

Wings are rectangular in plan form and set at an angle of incidence of 0 deg for both The lower wing is set at a dihedral of 4 deg while the upper wing is flat The cellule comprises one upper and two lower panels, a center section cut-out being provided in the upper panel to improve visibility and facilitate parachute exit The upper wing has an area of 99 7 sq ft and the lower panels each have an area of 47 35 sq ft A Clark "Y" airfoil section, expanded to 15 per cent, is employed

SPRUCE SPARS and aluminum alloy ribs are used in the wing structure The ribs are built of heat-treated duralumin stampings 014 in in thickness excepting those whose extended cap strips carry the aileron hinges, these being of 045 in. stock A flanged "U" section is employed in the cap strip while the vertical members are of channel section The cap strip section is 1 in in overall width, including the two ¼ in flanges, and $\frac{11}{32}$ in deep The channel section is ½ in wide by ⅜ in deep Duralumin rivets $\frac{1}{16}$ in in diameter are used in fabricating the ribs which weigh approximately 5 oz each Nose ribs of curvature different from the former ribs to prevent fabric sag are inserted between the former ribs Cement coated nails are used to attach all ribs to the top and bottom of the spars These nails merely locate the ribs as the upper and lower cap strips are tied to the spars In order to avoid the difficult nose curvature of the ribs, upper and lower cap strips are made separately and riveted to the 030 duralumin leading edge Trailing edge, center section cut-out and wing end bows also are of 030 duralumin, heat-treated Walkboards are of 065 duralumin and will support a man at the trailing edge with a safety factor of three

A front quarter view of the Warner powered Model 1 Fleet biplane showing the landing gear and cowling

The aluminum alloy used in the wing structure is of high tensile strength and is of the same composition as that used on the first 50 PT models built by the Consolidated Aircraft Corporation and which have been in service for four years A special heat treating furnace has been developed and is installed close to the stamping press to insure a continuous flow of materials to the press

A view of the nose of the Fleet Model 2, showing the Kinner engine installation

A selected grade of airplane spruce is used in the wing spars, which are rectangular in section The upper wing spars are built up of three laminations and are $1\frac{1}{8}$ in. wide, the front being $4\frac{1}{8}$ in deep and the rear $3\frac{7}{8}$ in deep The spars of the lower wing panel structure are of the same dimensions as those of the upper wing but are solid

Six bays are made in the drag bracing of each lower wing panel and eight are provided in the upper wing exclusive of the center section The single unswedged tie rods, employed for rigidity rather than strength, are set at an angle of 45 deg This setting has been found by experience to give the greatest rigidity in this type of bracing Compression struts are $\frac{7}{16}$ x 028 in chrome molybdenum steel tubes, cut off squarely in a lathe and set over the heads of the drag wire fitting bolts

Each drag fitting is attached to the spar by a single bolt through a Bakelite spool inserted in a reamed hole and large duralumin disks ⅛ in thick are placed on the faces of the spars This makes attachment a rigid assembly and prevents washers from embedding themselves in the spars

The main wing fittings are of one-piece design the single welds being under practically no stress They are bolted to the spars through Bakelite spools inserted in reamed holes, increasing the bearing area in the wood by 150 per cent and eliminating the trouble caused by bolts embedding in the spar The layout of the position of these bolts is such that the centroid of the bearing area in the wood coincides with the truss center line This eliminates rotating tendency between the fittings and spar and prevents one bolt from taking more than its proper share of the load This is quite important as a small shift in the location of one bolt will add 25 to 50 per cent to its load and cause premature embedding in the spars

It is possible to replace either front or rear spar in either upper or lower wing panels without destroying or losing a single rib or fitting, a point of great advantage in training operations where minor crashes are frequent

Ailerons are provided on lower wings only as the upper wing reaches the burble point 8 deg earlier than the lower The aileron structure is of wood, the leading edge is a fairing of 014 duralumin Ailerons are balanced by locating the hinges behind their leading edges and the hinge fittings on the wing structure are riveted into the ends of the previously mentioned extended cap strips of the ribs A single long hinge pin is provided for each aileron and is inserted through a hole in the wing end bow, engaging all hinges when they are in alignment The end of the pin is bent flattened and fastened to the tip bow by two screws

ONE OF the most interesting features of the Fleet airplane is the patented aileron control system The system is extremely simple and consists essentially of a push pull tube in each wing connected directly to the stick and attached to a lever pivoted to the aileron on an axis inclined in both front and side elevation Motion of this lever transversely moves the aileron up and down with a differential action As the operating lever attached to the aileron is telescoped, assembly of the aileron to the wing is a simple matter The wing structure is protected by three coats of spar varnish

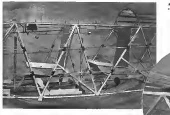
An original feature in the production of the plane is the patented method of attaching the fabric to the wings Holes 05 in. in diameter are punched into the cap strips of the ribs and a tapered end punch and die is then run through each, producing bell mouth holes 089 in. in diameter The fabric is next applied to the structure and a $\frac{3}{8}$ x 020 in duralumin washer is laid on the fabric over each hole Attachment is made by the use of No 4x$\frac{1}{4}$ in Parker-Kalon sheet metal screws, having special heads These screws, when used in this size and type of hole, will not come out even if the thread is damaged Round fabric patches one inch in diameter and stamped out in large quantities at the factory, are doped on to the fabric to cover the screwheads

Single streamline wire trusses are used in the external bracing and consist of two flying wires and one landing wire. The flying wires are $\frac{5}{16}$-24-6100 and the landing wire is $\frac{1}{4}$-28-3400 The stagger is 23 in and the bracing wires are in the plane determined by the rear upper and front lower spars The center of the lift forces in flight comes very close to the plane of this vertical truss, resulting in very little torsional stress on the wings and geeat rigidity Wing heaviness can be corrected in the air by adjustment of the left diagonal center section strut, the adjustment nut being located within easy reach of the pilot

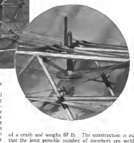
The static tests with balanced and unbalanced loads, conducted on the wing cellule indicated load factors of four for inverted flight, six for low incidence and 11 for high incidence conditions In the inverted flight test, sand bags were piled on the upper surface of the wing to a load factor of four and the load was then unbalanced by removing one load factor from the right wing In the low incidence test, sand bags were piled on the lower surface of the wing to a load factor of six and the load factor was unbalanced by removing 1.5 load factors from the left wing In the high incidence test, the load was carried to a factor of eight and unbalanced by removing 30 per cent of the load from the left wing These tests were all successfully carried out without signs of failure though with some permanent deformation

Loading was resumed after the high incidence unbalanced test and carried to a factor of 10 where some bending of the interplane struts was observed Some of the sand load was piled against these strips for the following loads to retard their failure The struts held a load factor of 11 for about 10 sec after releasing all jacks before the left wing failed through the buckling of the interplane struts Subsequent inspection of wings showed only minor elongation of holes As no flight load of so geeat intensity lasts as long as 10 seconds it is assumed that the structure will carry a load of 11 factors under actual flight conditions

The welded chrome molybdenum steel tube fuselage is designed primarily to protect the occupants in the event of a crash and weighs 87 lb The construction is such that the least possible number of members are welded at each joint and the bracing members are so placed that shrinkage is neutralized and at inclination determined after careful investigation Special tubes are incorporated in the structure for no other purpose than to anchor the safety belt triangles A Warren truss is provided in the plane of the front seatback and welded to a cross in the bottom of the structure Parachute seats are provided and all supporting members are designed to withstand severe impact The standardized type of detatchable clip, used to make attachments to the fuselage structure, has been employed for a number of years by the Consolidated Company This clip is fitted around the tubes and permits attachment without welding to the structure. Wood fairing strips, attached to curved cross members by standard clips, constitute the turtle back The engine mount, having a patented three point support for the mounting ring, is designed to eliminate all internal stress due to welding shrinkage. Many failures in multi-membered engine mounts are attributable to these shrinkage stresses The method of attaching the engine with self-adjusting clips further reduces the initial stresses in the mounting



A portion of the uncovered fuselage of the Fleet biplane showing construction and installations



The screw type stabilizer adjusting mechanism of the Fleet plane Several of the standard attachment clips also are shown

A divided axle type of landing gear having a 64 in tread and oleo and spring shock absorbers is provided The landing angle is 15 deg 20 min The oleo cylinder design is such that all oil leaking out at the upper gland is trapped and fed back into the chamber It therefore can be manufactured without oil tight joints The oleo action has a seven-in effective stroke at the wheel and the spring action, intended for taxiing, has a four in effective stroke at the wheel The oleo element can be easily detached and filled from the outside and, after being detached, can be disassembled by the removal of one nut

Axles are heat treated streamline tubes The loop joint of the landing gear is so designed that there is no sudden change in section, eliminating the possibility of fatigue failure Drop tests were conducted on the landing gear with 20x4 in wheels under a 1 680 lb load and later the same fuselage and landing gear was drop tested with 24x4 in wheels Landing gear attachment fittings are drop forgings welded on in such a manner that they can be replaced at major overhaul without damage to the fuselage structure The lower wing hinge attachment fittings are also drop forgings and can be replaced at overhaul Center section strut attachment fittings are of laminated chrome molybdenum steel

The tail skid is also fitted with an oleo cylinder of the same type as that of the landing gear but having a six-in. oleo and spring stroke A quickly detachable manganese steel shoe is furnished and dovetails into a fitting on the end of the shock absorber plunger The shoe is locked in place by a wire This type of tail skid has been in long service over frozen fields and has given proof of its efficiency

Tail unit structures are built up of chrome molybdenum steel tube spars with sheet steel channel ribs, sheet steel trailing edges and tubular leading edges A special hinge arrangement which is a development of the hinge used on all Consolidated army PT models is employed for the elevators A feature of this hinge, which is attached by two bolts, is that it provides that no wear take place on the elevator or rudder torque tubes as there are shouldered bushings around these tubes which take the wear from the hinge straps All steel tubing is protected against corrosion and hermetically sealed and other steel parts where possible are cadmium plated Both fuselage and tail surfaces are covered with fabric and doped The fin is adjustable on the geound and the stabilizer is adjustable in flight

Dual control is provided for the stabilizer adjustment which is simple self-locking and weatherproof Removal of a single bolt completely disassembles this control The vertical guide just forward of the adjusting post takes side forces out of the front of the stabilizer eliminating any chance of binding the adjusting screw

The adjusting mechanism consists essentially of a vertical screw actuated by a deep groove aluminum pulley which is itself operated by a $\frac{3}{32}$ in endless spliced cable The cable runs along the left side of the plane to a point forward of the cockpit and adjustments are made by pulling the cable in the desired direction The design of the pulley is such that the cable cannot slip and the arrangement eliminates a number of parts used in the conventional types of stabilizer adjusting mechanism Its simplicity makes it readily adaptable to production Zippers are provided in the fuselage covering for inspection of the stabilizer adjusting mechanism Simplicity is characteristic of the dual control system The bolts at the lower end of control sticks are ground bolts and run in steel bearings It has been found that bronze bushings are unable to stand the high bearing pressures at a joint of this character All of the bearings in the control system are die cast, oil-less bronze bushings and are designed to a bearing stress of 700 to 800 lb per sq in. Stamped brass bearings are used for the interstick torque tubes Push-pull tubes are employed in aileron and elevator control and cables with spring

Phantom view showing operation of the aileron control mechanism

The stamped duralumin ribs set up preparatory to static testing

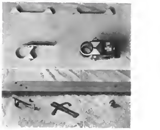
Set up of the inverted flight static test on the Fleet biplane cellule with unbalanced load factors four and three

return are used for the rudder pedals The dual controls can be disconnected easily if desired

Another interesting feature of the system is the dual throttle control which also is placed on the left side of the seats This consists of a push-pull rod passing through both cockpits and having ball handles for both occupants The motion of this rod is transformed into lateral motion to actuate the throttle rod by means of a third member which is pinned to the forward end of the push pull rod and attached by a Cincinnati ball joint to the throttle rod The push-pull rod passes through holes in the sides of two supporting channel members and is fitted with simple friction clips in each channel which hold it in position eliminating the use of a quadrant Fixed spark is provided on all planes after the first twenty-five in which it was found that controlled spark was of no value. Dual switch and fuel shut-off control are provided Consolidated and Pioneer instruments are furnished in the forward cockpit

The fuel system consists mainly of the 24 gal gasoline tank which is built into the center section the ⅜ in x 0 032 in copper tube fuel line and the primer and shut-off cock An Army type C-1 strainer made with special size tapped holes to save bushings and fitted with a Parker ⅜ in, drain cock also is included Parker fittings are used throughout and several have been developed specially for various purposes The tank is held in place by three straps and is fitted with two outlets to provide gravity feed in all attitudes of flight An 0 018 in terne plate fire wall separates the cockpit from the engine compartment and cowling of 0 050 and 0 035 in aluminum is used to enclose the compartment. Attached to the firewall is a cylindrical oil tank of 0 018 terne plate The tank has a capacity of 2½ gals and a filling mark at two gallons Equipment includes a wooden

The three point engine mounting of the Fleet Model 1 showing another use of the standard clips



Top—Torque tube bearing and adaptations of standard clip
Bottom—Wing and drag fittings and method of attachment

propeller, but a metal adjustable propeller also can be provided A Heywood air starter can be furnished as optional equipment

The specifications as furnished by the manufacturer are as follows

Length overall	20 ft. 9 in
Height overall	7 ft 10 in
Span each wing	28 ft
Chord each wing	3 ft 9 in
Airfoil section	Clark Y expanded to 15 per cent
Gap (at C S)	54 in
Stagger	23 in
Angle of Incidence (Both wings)	0 deg
Dihedral (Upper)	0 deg
Dihedral (Lower)	4 deg
Area of wings, total	194 4 sq. ft
Area of horizontal tail sur	23 4 sq. ft
Area of vertical tail sur	9 9 sq. ft
Propeller clearance (8 ft. prop)	10 in, flying position
Weight empty (Model 1)	976 lb
Disposable load (Model 1)	554 lb
Gross weight loaded (Model 1)	1,530 lb
Weight empty (Model 2)	1,022 lb
Disposable load (Model 2)	560 lb
Gross weight (Model 2)	1,582 lb.
High speed (full load sea level, Model 1)	111 m p h
High speed (full load, sea level, Model 2)	113.5 m p h
Cruising speed	90 m p h
Minimum speed of flight	40 m p h
Climb at sea level	930 ft per min
Ceiling	16,000 ft
Gasoline capacity (normal)	24 gal

The following features on this airplane are either patented or have patents applied for aileron control mechanism, stabilizer adjusting mechanism, seat construction, engine mount construction, wing ribs wing fittings method of attaching fabric, oleo shock absorber, throttle control, method of adjusting lateral balance standard clips used in supporting cowling, seats flooring etc

THE *Series C* "WASP" ENGINES

A NEW "WASP" engine embodying several modifications in the design of previous models has been placed in production by the Pratt & Whitney Aircraft Corporation of Hartford, Conn This engine which is designated "Series C" has a commercial rating of 420 hp at 2,000 r p m and a military rating of 450 hp at 2,100 r p m Geared and supercharged models as well as the direct drive type are available

The Series C engine has passed a number of flight and dynamometer tests to the satisfaction of the manufacturer As a final check an official 50-hr Navy test was run during which the engine developed an average of 465 hp at an average speed of 2,080 r p m The average fuel consumption was 0 524 lb per b hp hr and the average oil consumption 0 014 lb per b hp hr The dry weight of this engine was 684 lb, giving a weight per horsepower of 1 47 lb Throughout the test no repairs or disassembly inspections were made The engine was operated at full throttle for the entire period Power as well as fuel and oil consumption remained practically constant throughout the fifty-hour test At the conclusion of the test the engine was completely disassembled for inspection It was found that all parts

The vertical finning and the new style of rocker arm and bearing

were in excellent condition and that it was only necessary to replace three piston rings and two valve springs to put the engine in first-class condition again

One of the important modifications in the Series C Wasp engine is the improved cylinder head design which involves a new method of finning On account of the

improved cooling, the life of the cylinder head, as well as of the exhaust valve, has been considerably lengthened. A change has been made in the shape of the exhaust valve which further increases the length of life of these parts More rigidity has been provided in the crank shaft through a redesign which increases the diameter of the crankpin and the thickness of the crank cheeks The rocker arm design has been changed so that the four bearings supporting it are carried in the rocker instead of in the cylinder This arrangement facilitates the removal of the rocker arms and better provides for retaining the lubricant in these bearings On both military and commercial engines a slipping member has been interposed between the crankshaft and the impeller drive to relieve the drive of accelerating and decelerating stresses A forged aluminum nose section is now being used instead of the casting formerly employed This is practically twice the strength with a little less weight Steel drive gears have been substituted for duralumin in the magneto and pump drives This provides for a much longer life for these parts Reduction in operating cost has been achieved by modification of the master rod

bearing which now has a life of from two to three times that of the original type

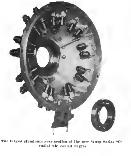
The increase in performance is attributed by the manufacturer to the improvement in cylinder cooling. A new type of hot spot combined with a preheater eliminates ice formation and provides the proper distribution in cold weather Modifications in the carbureter give much better acceleration

Among the miscellaneous improvements is a large oil sump which obviates any possibility of oil accumulating

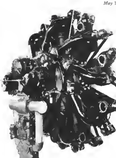
The patented 2:1 reduction gearing with the automatic equalization device

in the lower cylinders while the plane is at rest Provision has been made for greasing the top of the push rod by means of a drill hole from a Zerk fitting on the rocker arm axle The intake pipe flanges have been improved by a stiffening bead around the edge. A drain plug has been provided in the sump to permit of draining the oil at this point A steel liner has been placed in the nose section to carry the thrust bearing

None of the features embodied in the original Wasp models have been discarded All of these have been retained such as the forged aluminum main crankcase, enclosed valve gear carried in patented integral housings on the cylinder head, one-piece master rod and divided crankshaft as well as rotary distribution and location of all accessories at the rear of the engine



The forged aluminum nose section of the new Wasp Series "C" radial air cooled engine

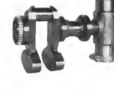


Rear quarter view of the engine showing accessories

The supercharged model has the same sea level rating as the unsupercharged military engine The supercharger is designed to render the sea level power available up to 5,000 ft. Several patented features are embodied in the geared model which is only slightly heavier than the direct drive type After a long series of experiments a bevel type of two to one reduction gearing has been developed with automatic equalization of the pinions so that each carries its proportion of the load

Improvements have been made not only in the design of the engine but also in the fabrication and testing of its parts In an effort to produce high quality equipment, an extremely rigid test and inspection system is employed A single standard of quality is maintained for both military and commercial products An engine picked at random out of each lot is given a fifty-hour type test as a check on the fabrication and inspection methods This insures a thoroughly tested and proven product

The crankshaft assembly of the new Series Pratt & Whitney engine



THE Licensing Section OF THE AERONAUTICS BRANCH

By Donald E. Keyhoe

A SHORT time ago a man hurried into the Licensing Section of the Department of Commerce at Washington and demanded to see Chief Jesse W. Lankford immediately

"I've been working over two years for the X——— Aircraft Engine Co.," he stated, producing supporting evidence. "I'm not with them now but I've got a chance at a good job out West. I need a mechanic's license to get it, and I have to start tonight or I'll be too late"

Lankford stopped his work and gave the man his personal attention In a short time the applicant was busy with the examination But when he had finished trouble developed Before officially completing and marking the papers, Lankford saw that the rating would be too low to pass the man He privately called one of the inspectors, a man with a wide reputation for fairness, and explained the situation

"I think maybe an oral exam would show that he knows his stuff," said Lankford "At least, it can supplement this paper Will you talk with him?"

The inspector readily assented and came over to quiz the applicant But the man soon showed that he was not qualified He knew nothing of adjusting a carbureter, not even on the type of engine with which he had worked He described a distributor when asked to explain a magneto He simply did not know It appeared that he had worked on assembly of engines, and could by no means be considered an all-round mechanic

Lankford courteously explained the qualification for licensed mechanics in telling the man he had not passed, the inspector in a friendly way told him the best method to round out his experience in order to be ready for a "trouble-shooting" job such as he was trying to get They were really sorry, they had already slightly stretched the rules to try to get him by, but, of course, they could not turn loose an inexperienced man with Departmental approval

The applicant was furious He denounced both men and ended up with a tirade about the Department

"I've heard about you people," he said savagely, "doing everything you can to keep fellows from getting by"

He went on out, muttering something about a "bunch of smart-alecks"

His statement is peculiarly indicative of a belief held by too many people in the industry Applicants who have been refused licenses, or held up for a time, have sent in red-hot letters, sizzling telegrams, and have bawled out almost everybody from the Assistant Secretary down to the mail clerks They are still doing it—though not quite so loudly as at first

They complain of "officious busybodies," and many sincerely think that the officials of the Licensing Section rub their hands with glee when they turn a man down That is ridiculous, of course Every rejection, or interrupted case means a lot of extra work and overtime, and it is fairly obvious that a straight case must be gladly welcomed But this is too simple a defense to be well received Perhaps a brief analysis of the licensing work, with some bona fide instances of "kicks," relating both sides, will assist to clear up the misunderstanding

These are the steps in licensing 1 The application is received 2 It is checked as to necessary information, not for precise form (Few applications are letter perfect) 3 It is sent on as soon as a copy of the medical examination is received. (This is a frequent cause of delay, as applicants send in their applications and forget about the physical tests until notified, though this is plainly covered in the regulations) 4 A card record is made, cross referenced to eliminate duplication 5 One copy of the application is sent to the inspector by whom the applicant is to be examined (Here is another difficulty Pilots move around constantly Often the first address is obsolete in a week and the Department sends out the application to an inspector only to learn the next day that the pilot wishes a test in a district hundreds of miles away Sometimes papers are mailed and remailed several times before they finally catch up—because the pilot doesn't plan to take his test at a definite place at a definite time) 6 After the inspector has *found* the man and examined him the papers are sent to Washington. 7 If the examination is satisfactory, the license is issued 8 A record of the license is made in the official ledger and reported publicly (This last step need not be considered, as it cannot hold up a license in any way)

Of the seven steps up to the actual licensing, five are directly dependent on the applicant for speed of execution That is, he can, and often does, make errors in one or more steps which hold up his license for a long time.

If the first application is correct and the medical report is sent in at the same time, or before, there will be little delay in getting the card record made and the papers sent to the proper inspector. The applicant is notified as to the inspector's itinerary, so he can choose a meeting place and time. If he connects at the earliest possible moment, not more than two weeks should elapse between time of applicant's notification and taking of the tests, even if the inspector is at the most distant point at time of notification. Of course, at flying centers, there is usually a large number waiting, but inspectors expedite the examinations as much as they can. If the examination is satisfactory, which certainly depends only on the applicant, the papers will be sent in at once to Washington. There they are reached as quickly as volume of work permits. This last is a significant sentence. During the busy season in flying—from early spring to late summer—the whole Department is swamped, especially the Licensing Section. And there is no remedy, for those who dictate in regard to Government personnel and appropriations cannot be moved to furnish adequate personnel even in this rush period. So in that period there will always be a holdup from the time when the papers are sent in by the inspector to the day when the license is mailed. It can't be helped—there just aren't enough people to handle the hundreds of applications that pour in.

But issuing the license does not end all trouble. Renewal is a simple word, but it isn't simple in effect. Thirty days before a pilot's license is due to be renewed he is notified. The Department is not required to do this, for the date is shown on the face of the license, but hardly any pilots will remember to renew unless warned. The 30 days gives them time to take a medical examination and get a renewal.

PROCEDURE for licensing airplanes is about the same as that for pilots, except of course that there is no medical. Complaints are plentiful in this part of the work, too. But an anlysis shows that about 75 per cent of the delays are caused by carelessness on the part of applicants. For instance, a man buys a plane second-hand and wants to use it at once in interstate commerce. He rushes a telegram to the Department. "Wire me temporary license number my Waco bought from John Jones. Send L—— Airport by tomorrow morning to cover trip already contracted for then."

Now the Department cannot take a chance on licensing a plane without establishing ownership, eligibility of plane for license, and citizenship of owner. If it sent out numbers indiscriminately on such requests it would be easy to steal planes and "trade" without any record. So it wires back (some Government departments would write):

"Department must have type, serial number, and proof of ownership. See Air Commerce Regulations for details. Letter follows."

The owner is indignant. His trip is off and he has lost money—all because of a "finicky bunch of red-tape artists at Washington." He says so, loudly, and his friends agree that he has had a raw deal. It is easy to criticize the Government, and a popular pastime.

Perhaps the owner takes a chance and flies anyway. If this comes to the attention of an inspector he reports the owner for a violation, and possibly a fine will follow, though more likely a warning. The owner is more resentful than ever—even if he gets off with a warning.

All kinds of odd situations come up in licensing of planes. Bill Johnson applies for a license for his plane and on examination an inspector finds the craft unairworthy. Bill gets an identification number, so he can't fly in interstate commerce. He waits till the inspector is gone, paints out the numbers, gets a "green" prospect and sells the plane, assuring the buyer that it is a reconditioned plane, as good as new, and will be licensed by the Department on application.

After Bill Johnson vanishes the new owner finds that his plane is a lemon, and he can't use it in business as he planned. The Department is the one to tell him when he applies for a license. And from that time on he feels a strong resentment against the Department because it was the messenger of the bad news.

PERHAPS Bill Johnson doesn't bother to sell the plane, or maybe he can't find an easy mark. Then he tries another trick. The only difference between an identified plane and one temporarily licensed is a metal plate in the cockpit of the identified one. So Bill calmly takes it out and throws it away. From then on he flies the plane as a temporarily licensed plane—illegally to be sure, but he has a chance of getting away with it for a while, because of the few inspectors allowed the Department and his habit of being "somewhere else" when they come around.

However, this trick will soon go into the discard. Inspectors are getting to know most of the planes in their districts and are on the lookout, and a new system is going into effect, requiring cards in every plane showing the status, whether identified, or temporarily or permanently licensed.

Resale of planes causes one of the greatest difficulties. The owner often waits to report, which is a violation in itself. When he does he fails to send the bill of sale, or he has lost it, or never had one. Frequently a conditional bill of sale is sent, in which the original owner holds the title until the last payment is made. The Department cannot accept that, and another mixup occurs.

A view of the tail end of a Ford tri-engined monoplane, showing the license number on the rudder

A single case shows how complicated the bill-of-sale matter can become. A barnstormer sold a war surplus plane, and it was resold three times without any report being made to the Department. The fifth owner decided he wanted a license, or a reassignment of number. He applied. The Department asked for a bill of sale, expecting one signed by the barnstormer who had first owned the craft. The bill sent in showed the fourth owner, of whom the Department had never heard. So the fifth owner had to start a hunt. He finally found the third owner, and learned to his dismay that he was only started on the trail. He is still looking for the first owner, who seems to have mysteriously disappeared. Perhaps he never owned the plane in the first place—for the Department of Commerce cannot guarantee titles, although it is often asked to do so.

The second, third, and fourth owners in this case violated the regulations, but that does not help that fifth owner in getting a license. The Department is as lenient as it can be in this matter. It will accept bills of sale from the nearest kin of former owners, if they have died, and it does its best to get around bad situations. But it has to recognize established principles of equity. No one complains very much if a State Motor Vehicle Commissioner refuses to give a license tag without an automobile bill-of-sale, but when an airplane owner is refused for the same reason he honestly believes he is the victim of persecution. At least, letters to the Department indicate such a state of mind in many cases.

HOME-MADE PLANES add to the trials of the licensing section. A number of young men have purchased plans of planes, often close copies of approved-type aircraft, and have built their own planes. Then they ask for licenses, stating that their planes are of approved-type. Of course they don't get licenses, unless they submit bona fide stress analyses and other required data, for the approved-type certificate covers only planes built in the factory for which it was issued. Otherwise cheap copies of popular planes could be made and sold in competition with the factory ones, poor material might go into them, and bad methods of construction would constitute a danger to buyers and passengers.

The war-surplus stock gave trouble until a decision was reached. These planes are eligible when of original design and specifications, but any modification, such as the "clipped-wing" type, renders the license void. These planes are not to be confused with "approved-type" which are built under Department supervision. The war-surplus plane is subject to a line inspection, and inspectors will often rip open the wings to determine the state of spars and ribs. This is the only way to find out whether a plane is safe for a public vehicle, but, of course, it is not popular with owners and naturally there are complaints.

But if plane owners protest, their complaints are equaled, at least, by the chorus from pilots and mechanics who have been turned down or whose licenses are delayed. At least half of the "kicks" come from those who just didn't have the "stuff." Inspectors aren't turning men down summarily—that doesn't go now, if it ever did, for Director Young has repeatedly ordered them to use common-sense, and give applicants the benefit of the doubt if it does not create a danger to the industry and the public. (This subject will be fully treated in a later article on the Inspection Section.)


Maj. Clarence M Young director of the Aeronautics Branch Department of Commerce

When an applicant is rejected, there is little doubt that he deserved it—that he simply was not qualified. But still the men who fail wire, phone, or dash into the Department insisting on a second chance at once. At first they complained of "raw deals." When the inspectors had been almost invariably found to be right, the failures shifted their tactics and found excuses ranging from illness on the day of the test to bad weather. Most of those who hurriedly try for new tests believe they will get the seme questions with which they are now familiar. Some even rush over into another district and apply to a new inspector, carefully refraining from any mention of the first tests.

This used to get by for a while, but the practice increased so much that a new "desk" had to be created to catch these repeaters. The 90 day interval between examinations is seldom waived now, and the questions are changed in that time, so that loophole has been closed. But there is still a steady stream of requests and demands for immediate second tests, backed up by influential recommendations, and occasionally hints of trouble if the request is not granted.

MANY OF the complaints come from two classes of pilots. The first includes wartime pilots who have been out of the game since 1919 and come back, expecting to be in first-class condition after a few minutes in the air. When they are turned down because of faulty flying they indignantly point to hundreds of hours in the air. The second group includes men who took 10 hr. of dual instruction at a commercial school and have built up 200 hr. or more flying passengers at airports. They are fair for straight flying but are not capable in many instances of doing transport work, cross country, and sometimes can't even pass the flight tests for "transport" exclusive of cross country experience.

Of course there are exceptions, and some fine pilots have come out of this class. But many have to be rejected, and they howl loudest of all. Undoubtedly they feel justly aggrieved, for they have been flying steadily and here is a Department about to take away their means of livelihood. No inspector wants to do that—yet on the other hand those pilots are a menace in the transport game until they acquire more experience. This is one

of the most difficult problems, and it causes a lot of dissension, but as long as passengers' lives are at stake the Department must turn down such pilots

A few fliers assumed a hard-boiled attitude One man wrote in and defiantly stated that he did not have to submit any evidence of six hours flying in the 60 days preceding his renewal request The licensing section simply sent him a copy of the regulations, calling attention to the proper paragraph.

Back came a fiery letter addressed to Assistant Secretary MacCracken, saying, in effect, that some impertinent clerk had insulted him and was deliberately trying to keep him from getting a renewal

A more striking example occurred when a well-known flier requested a license He made the request orally but on account of certain circumstances the Department went out of its way to rush out an inspector with application blanks, ready to give the examination The flier became greatly offended at the idea that he needed an examination, and said in no uncertain terms that if his reputation was not sufficient for the immediate granting of a license he didn't care for one He said he had no time to waste in taking any examination, although the licensing section had waived all but the flight test, which procedure was possible at that time

A pilot barnstorming around the country was recently notified at his latest address that his license was due for renewal No answer A second notice was sent, and then a new address was given the Department by someone at the first location The usual expiration notice was then mailed to pilot at this new address, as the period was more than up In a few days a vitriolic letter came from the pilot, in which he claimed to have requested the Licensing Section weeks before to accept a Canadian medical examination No such letter had even been received. He indicated that he considered the expiration notice as an uncivil and unobliging answer to his request, ignoring the fact that it was not sent until after two attempts to locate him He continued with a bitter attack on the Department, closing with remarks which can not be quoted

It is logical to assume that no request for acceptance of the Canadian examination had ever been sent Even if it had, the fact that the Department had not answered should have stirred him to write again Had the letter been received, the renewal would have been made, for the Medical Section will cooperate to that extent and more.

The Licensing Section has become accustomed to such letters, of which many are sarcastic and a few full of threats to have "some dumb clerk" fired It might surprise those who complain of ignorant clerks to know both Mr Lankford and Mr Paulette chief and assistant chief of the Section, are pilots and well acquainted with flying problems Moreover, they follow strictly the rule laid down by Director Young Look at each case through the eyes of the operator or the pilot Remember, you may be taking bread and butter out of a man's mouth if you ground him or his plane, keep them flying if you possibly can

Lack of personnel, small floor space, and minor administrative problems contribute their part to the trouble But in spite of the kicks that still come in, the Licensing Section has as fine a morale—if not the finest—of any Governmental unit. During the summer months, when the Department's buildings are as nearly at fever heat as the aviation industry at that time, the clerks of the

A view of the left wing and tail of a Cessna monoplane illustrating the placing of license numbers

Licensing Section average four nights a week overtime to get licenses out And they do not get a nickel extra for it The Government cannot compel such overtime except in a great emergency If the force suddenly became tired of the complaints and went back to standard hours the work would stack up until half the planes would be grounded and probably as many pilots unlicensed

One remedy for the difficulty is decentralization In view of the dismal prospect for more personnel, this will undoubtedly occur within a year That is, there will be three or more licensing offices at strategic points in the United States In that way, a man in California will not have to wait the long period which is now necessary for mail to go back and forth to Washington

Also, the requirement for physical examinations every six months may be changed so that on the recommendation of inspectors a pilot's license may be renewed for a year without a medical Some oppose this, claiming a pilot ought to be examined frequently, but it is pointed out that an inspector can keep track of crashes in which pilots may be injured, and will undoubtedly note any unusual conditions requiring a physical test when the applicant comes for his renewal recommendation every 6 months That is, evidence of a dangerous condition This subject is under discussion, and a decision will probably be made before the end of the year

All this is indicative of the Department's attitude. It is trying to clear up the difficulties Complaints from the outside haven't slackened those efforts, for the officials realize that the industry simply does not understand. The men in the licensing section admit that it is human to kick at delays, even though the person complaining may have a good idea that he is to blame

So the Licensing Section is plugging ahead—but if a few bouquets were mingled with the brickbats those in the office might labor a little more cheerfully At least it would vary the monotony

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This is the third of a series of six articles prepared by Mr Keyhoe dealing with the Aeronautics Branch, Department of Commerce. The fourth article will appear in an early issue—EDITOR.

PROTECTING THE *Balloonist* FROM LIGHTNING

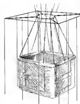
By WARD T. VAN ORMAN
Balloon Pilot for Goodyear Tire & Rubber Co

UNTIL 1923, balloon racing had encountered no serious accidents Men had flown in balloons for many years without interference from their most deadly foe, lightning, but in 1923, three of the balloons starting in the James Gordon Bennett race from Brussells were struck, with fatal results to five of the six occupants of the baskets

In 1924, Lieut James Neely and Dr. LeRoy Meissinger sacrificed their lives at Scott Field, Ill., to secure data on storms, with lightning again being responsible In the 1928 national race at Pittsburgh, Lieut Paul Everet, an Army entry, and Walter W. Morton, my aide, were killed, and several others seriously injured

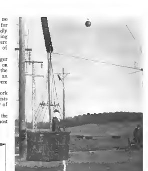
With the need of protection so obvious, I began work on a device which would satisfactorily protect balloonists from the ravages of lightning, and after nearly a year of experimentation, have perfected a shield

The problem of protection of the balloonists and the balloon was divided into two phases The first and most important is the protection of the occupants of the basket, and this we have accomplished In accordance with customary practice, suspension of the basket from the bag is by ropes A metal load ring is used instead of a wooden one, however The new load ring is constructed of 2½-in. steel tubing, having an 0.049 wall gage, and is 30 in in diameter, slightly larger than the old wooden type



Extending diagonally across the load ring are two cross arms of ½-in aluminum tubing, having a $\frac{1}{32}$-in wall gage From the corners of the cross arms, heavy copper wire is carried, forming a rectangle 12 in larger than the basket From this rectangle 12 flat braided No 12 copper wires, 9 ft in length and equally spaced, drop down

The shield as it now stands has been thoroughly tested out at the outdoor laboratories of the Ohio Insulator Company, Barberton, Ohio, where single impact discharges of 3,000,000 volts, jumping a distance of 27 ft, are available This is in reality artificial lightning, and we put the shield through exhaustive trials



Above One of the tests conducted with artificial lighting at the outdoor laboratories of Ohio Insulator Company Left A diagram of the author's protective device for balloonists

Instruments placed within the basket show that none of the electrical discharges got past the protective shield and we therefore believe the balloonist whose basket is thus equipped is protected from lightning, as lightning is known to select the path of greatest conductivity Our problem was one of providing a more attractive path for the discharge than that formed by the bodies of the men in the basket.

Experiments have also been conducted with a protective shield for the hydrogen filled envelope itself, and considerable success has been encountered Small four and seven-foot balloons have been subjected to the same severe tests as the basket protective shield, with favorable results, but reports on these experiments will be made at a later date

Motor Truck ADVERTISING

VERSUS

Airplane ADVERTISING

By Willis Parker

Two years ago one of the arguments used in selling airplanes to business houses was the advertising value of such a transportation medium. The businessman was told that people would stare in interest, if not amazement, when his plane passed over. If his plane should land near a city or town, the newspapers would be hot on his trail immediately and a front-page story was almost certain. If he or his representatives used the plane in calling upon other businessmen, the very fact that the firm was sufficiently wide awake as to use an airplane in business would make a favorable impression upon them.

Two years ago, these conditions did exist, but with the ever-increasing use of airplanes for pleasure and for business, the public is not so "pop-eyed" when an airplane passes over the community, nor do people rush pell-mell to the cow pasture, wheat field or landing field adjacent to town to see the plane that has just landed and gaze in wonder at the pilot and passengers. Why, it has gotten so that many people never bother to look up when they hear the hum of an airplane engine overhead. The advertising value of an airplane, as contended two years ago, is decreasing rapidly—so rapidly, in fact, that to get advertising value out of a plane, the businessman must turn more and more to the advertising methods used in making the motor truck a publicity medium. In fact the same principles apply though in modified forms owing to the difference in position of an airplane in relation to the public compared to the position of a motor truck in relation to the public.

"We have found that in order to attract the attention of the public, we must use a special color scheme on our demonstrators," explains one aircraft company salesmanager. "Our standard paint colors—blue and silver—command no especial attention. If you visit any airport in the United States where there are many planes coming in and taking off, you will find that the plane carrying an unusual color scheme will command the attention of all. It is to our advantage, when on a demonstration trip, to command the attention of all of those who happen to be at the airport when we come in. Our demonstrators are painted in such combinations as dark red fuselage and cream wings, international orange fuselage and silver wings, black and orange.

"What holds true at the airport also holds true when the plane is in the air. It used to be that the hum of an airplane engine over a community caused people to drop their work and stand with heads thrown back to watch the plane as long as it was in sight—five minutes, fifteen, or maybe a half an hour depending upon the stunts and circlings of the plane in the vicinity. The hum of the engine today does nothing more, in some communities, than cause those who happen to be on the streets to glance quickly upwards, to assure themselves that what they heard actually was an airplane, whereupon they go about their business.

"However, if there is something distinctive about the plane, either in the color scheme or in the presentation of some advertising message, the citizen may give more attention to the plane than the mere single glance upward."

Because the airplane passes over the heads of the citizens of the community at an elevation of 2000 ft., as a minimum according to government rules, it is obvious that any advertising messages lettered on the wings or the fuselage must be presented in larger letters than the same message inscribed on a motor truck which passes the citizen just a few feet distant. Also, the environment of the airplane differs considerably from the environment of the motor truck so that when color schemes are considered, the environment in which the plane is flying must be considered.

White and silver are bad colors for airplanes in case the owner desires to be seen from the earth. Blue is another color that is hard to distinguish. Red, orange and black are excellent colors to provide distinctness.

Advertising the '-TP-' products of Texas Pacific Coal and Oil Company with markings on the wings and fuselage of its Ryan monoplane

Exploiting Packard cable through a sign, large enough to be read from the ground, which is carried on the underside of the wing of this Stinson monoplane

A "Wasp" powered Fokker Super-Universal, which has been fitted with "Movietone" equipment

"Good to the Last Drop" the advertising slogan for Maxwell House Coffee as it appears on the fuselage of this Ryan cabin plane

The tri-engined Ford monoplane, "Royal Air Truck," operated by The Royal Typewriter Company

What holds true with the entire airplane is also true in connection with the lettering of messages on the plane. Black on an orange background is much better than white or silver. That is, black is read easier on orange background than on white or silver because white and silver dazzle the eye by their reflections of the light.

If the message on the plane is to be read at a height of one or two thousand feet, the lettering must be at least 20 to 30 in. high. This precludes the possibilities of an extensive advertising message, though there is more space for lettering on an airplane than there is on a motor truck. Most firms who are using airplanes in business, such as the Texas Oil Company, The Standard Oil Company of Indiana, The Standard Roofing Company, the Texas Pacific Coal and Oil Company, The Royal Typewriter Company, use the company trademark as the principal advertising message to be carried by the plane.

Now there are three positions from which the airplane may present its message to the public. We have already mentioned a high position over the city. The second position is stationary at the airport, and the third is in the air lanes.

If the airplane owner feels that he wants to present his message to the people at the airport—attachés and visitors—he may increase the quantity of wording in his message. Take the Standard Roofing Company, for example. Besides mentioning the name of roofing material, the company letters on the sides of the fuselage the cities in which it has branch offices. Assuming that hundreds of persons may visit the airport while the plane is in town, it is quite likely that the names of the branch cities will have a good advertising effect. They can be read by the public while the plane is on the ground—not readily while it is in the air.

As more and more people fly, there will be more and more planes following the regularly established air lanes. An airline's passengers will be interested in any plane their plane happens to pass. The laws permit planes to pass within 300 ft. of each other, therefore the business house may well consider the advertising value of messages on the sides of the plane from the standpoint of presentation to the passengers of planes it may pass in the air lanes.

There are three positions on a plane for advertising messages—top, sides and bottom. The wings of planes vary from 25 to 100 ft. in span and from 5 to 10 ft. in width offering plenty of space for big lettering if the message is short. The side of the fuselage runs from 25 to 90 ft. in length and from 3 to 6 ft. in height.

Unlike the motor truck, it is impractical to put advertising on the front or rear of a plane because of the narrowness of these points. However, many firms and individuals give their planes distinctive names like Lindbergh did his "Spirit of St. Louis" and letter the name across the nose. The Standard Oil Company of Indiana had a plane called "The Stanolind." It sort of ties up the name of the firm and the product with the name of the plane. The Royal Typewriter Company has the "Big Royal." It's not a bad idea to have a distinctive name for one's plane, and, as we have just illustrated, the name may be made to have excellent advertising value.

GENERAL NEWS

Aviation Corporation Acquires Southern Air Transport, Inc.

Airline Deal Involves Six Subsidiary Concerns

NEW YORK (N Y)—Some 1,378 mi of passenger and 1,687 mi of contract mail routes are added to the national network of established aerial transport lines controlled by The Aviation Corporation, $200,000,000 holding and development company, with its newly-announced acquisition of Southern Air Transport, Inc, and its six subsidiaries

In a report to stockholders sent out by Lehman Brothers, various reports concerning the activities of The Aviation Corporation are confirmed, i e, that the holding firm has purchased interests in Western Air Express and the Aviation Corporation of the Americas and that patents for manufacture of German Rohrbach flying boats and of Armstrong-Siddeley airplane engines have been acquired.

Barrett and Carter Negotiate

Graham B Grosvenor, president, announced at the Chanin Building offices that the transaction involving passage of control of Southern Air Transport, Inc., to his concern has been consummated. While he did not reveal the exact nature of the deal, it is understood that an exchange of stock figured in The Aviation Corporation's obtainment of a majority of the southern company's 300,000 outstanding no-par-value shares. In these negotiations, A P Barrett, president of S A T, and Amon G Carter, publisher of the Fort Worth *Star-Telegram* and a director of The Aviation Corporation, played conspicuous parts.

Atlanta on the east and El Paso on the west are the terminals of the air lines operated by Southern Air Transport, Inc., and its subsidiaries. These are Texas Air Transport, Inc; Southern Aeromotive Service, Inc, Texas Air Transport Flying School, Inc., and the Dixie Motor Coach Corporation, Fort Worth, and Gulf Air Lines, Inc, New Orleans

Mail Routes Total 1,678 Mi.

Contract air mail routes No 21 from Dallas to Galveston via Fort Worth, Waco and Houston, and No. 22, from Dallas to Brownsville via Fort Worth, Waco, Austin and San Antonio, are flown by the Texas Air Transport. The Gulf Air Lines operate No. 29, Houston to New Orleans, via Beaumont and No. 23, from New Orleans to Atlanta, via Mobile and Birmingham. These air mail routes total 1678 mi. A 318-mi Houston-to-Brownsville route is also projected

Existing S.A T passenger lines, 1,387 mi in extent, all are operated by the Texas Air Transport Flying Service and the Gulf Air Lines. They include a Dallas-Galveston service, through Fort Worth, Waco and Houston, a Dallas-Brownsville route, through Waco, Austin, San Antonio and Corpus Christi, and a Dallas-El Paso line, through Fort Worth and Big Springs. Equipment has been purchased and operations are about to begin on new passenger routes from Houston to Amarillo, via San Antonio and Big Springs, from Houston to Atlanta via New Orleans, Mobile and Birmingham and from Amarillo to Dallas via Wichita Falls and Fort Worth

Represents Wright Corporation

Supplemental aerial taxi and charter services are maintained at Fort Worth, Dallas, San Antonio Houston and New Orleans by the Texas Air Transport. Flight instruction is given by the T A T Flying School, Inc., at its Fort Worth, San Antonio, Dallas and Houston schools. Southern Aeromotive Service, Inc, services the S A T fleet of 40 planes and is representative for the Wright Aeronautical Corporation in the Georgia, Louisiana, Texas, Oklahoma, New Mexico and Alabama, with service stations in Atlanta, Birmingham, New Orleans, Houston, Fort Worth, Dallas, and San Antonio. An auto bus system, which connects at Dallas and Fort Worth with the T A T air lines, is operated in Texas and Oklahoma by the Dixie Motor Coach Corporation

S A T flew a total of 45,978 mi on mail and passenger routes last year and in the first three months of 1929 its mail planes covered 125 190 mi and its passenger planes 65,356 mi on regular-schedule flights. Never in S A T history, it is said, has there been a mishap resulting in injury to any pilot or passenger

Added to the Universal Air Lines in the Mid-west, the Colonial Airways, in the East, and the Embry-Riddle air lines in Illinois and Ohio S A T brings the aerial transport routes The Aviation Corporation now controls up to more than 6,000 mi

Remove Mexican Export Restriction

WASHINGTON (D C)—As a result of restoration of Mexican Federal Government control over territory recently overrun by insurgents and with a view to continuing its policy of fostering development of commercial aviation between the United States and Mexico, the Department of State has again removed all restrictions on exportation of commercial aircraft to Mexico. Accordingly, individual export licenses are no longer required.

Experimental License Planes in Gardner Race

ST LOUIS (MO)—Maj Albert Bond Lambert, chairman of the Contest Committee for the Gardner Annual Trophy Race which will end at Parks Airport May 30, announces that the event has been opened to the latest type planes He said planes of new and recent design may be entered under a Department of Commerce experimental license instead of waiting for the approved type certificate of the Department.

The National Aeronautical Association, which has sanctioned the race, has decided to open the event to planes with an experimental license because of the appeal of a number of manufacturers who said that the regulation requiring an approved type certificate for each type of plane would eliminate their most improved models for competition.

Free engine oil for the contestants in the five preliminary races from Buffalo, N Y, Jacksonville, Fla, San Antonio, Tex, Denver, Colo, and Fargo, N. Dak, as well as in the main event from Parks Airport to the Indianapolis Speedway and return has been offered by the Kendall Refining Company of Bradford, Pa, and the Vacuum Oil Company. Free fuel will be supplied by the Naturaline Company of America. The oil firms also have posted prizes of $500 and $200 for winning planes using their fuel

Announcement of $700 additional in prizes by the Kendall company brings the total of prizes in the Gardner Race to $11,400. A total of $10,000 has been posted for the race by Russell E. Gardner, Jr., and Fred W Gardner, president and vice-president, respectively, of the Gardner Motor Car Company and $700 has been posted by the Vacuum Oil Company

Soucek Sets Altitude Record

Attains 39,140 Ft. Level In Wasp Powered Apache

WASHINGTON (D. C)—Official calibration of the barographs shows that Lieut Apollo Soucek established a new world's altitude record of 39 140 ft. over Anacostia in his flight May 8. He flew a supercharged-Wasp powered Navy Wright "Apache" 722 ft higher than the former record level of 38 4f8 ft attained by Lieut. C. C. Champion in the same machine in July 1927. The National Aeronautic Association regards acceptance of the mark by the F A I as a matter of course.

Lieutenant Soucek took off at 11 10 a.m. and landed at 12 25 p m. the entire flight taking I hr, 15 min. The height of his climb, it is said, was reached after

Lieut Apollo Soucek

45 min of flying. The supercharger used was of the Roots type developed at the experimental laboratories of the National Advisory Committee for Aeronautics, Langley Field, Va

Rulings stipulate that new altitude records, to be recognized, must exceed the previous highest level by f00 m. or 328 ft, hence Lieutenant Soucek was "to the good" after he had passed 38 746 ft.

Within a month, Lieutenant Soucek plans to attempt a new seaplane altitude record, with the Apache equipped with pontoons. In this try, the Lieutenant must again face a mark held by Lieutenant Champion, the latter having reached a height of 37,995 ft in the same Apache fitted as a seaplane 21 days previous to his record 38,418 ft. flight in 1927

Columbia Adopts Berryloid

NEW YORK (N Y)—Announcement is made by A. S Blumenthal, superintendent of Columbia Air Liners, fnc, that Berryloid aircraft finishes, made by Berry Brothers, Inc., Detroit, have been adopted for craft manufactured by that firm. The "Uncle Sam," "Columbia Triad" and "Baby Columbia," displayed by Columbia Air Liners at the New York show in February, carried coats of this finish

Shawmut Orders 50 Cessnas

WfCHfTA (KAN.)—While in Wichita last week H A Kenyon, of Shawmut Corporation. Boston, left orders with the Cessna company plant for 50 six-place monoplanes for f929 delivery. This supplements an order recently placed by the Curtiss Flying Service for more than $750 000 worth of Cessna monoplanes, a majority of them the four place machines

Expect Graf Zeppelin At Lakehurst Sunday

NEW YORK (N Y)—Complete arrangements for receiving the Graf Zeppelin in its second trans-Atlantic flight from Germany are being made here, with the great airship scheduled to leave Friedrichshafen May 15, as we go to press. Hugh Allen, of the Goodyear Zeppelin Corporation, general representative for the Luftschiffbau Zeppelin, and F W von Meister, technical representative, have been caring for the coming reception

Full passenger lists have been booked for the trip which is expected to end at Lakehurst N J, Sunday May f9 With the installation of new radio apparatus the Zeppelin will be in direct communication with Lakehurst all the way

Lubrication problems on the Graf Zeppelin's five Maybach engines, considered among the most important of the airship's mechanical details, have been solved with the result that at least one American product will be used on the trans-Atlantic flight

Continued operation of the engines for more than f00 hours at a time places unusual requirements on the lubricating oil, particularly on account of a number of developments in the method of operating dirigibles. Dr Hugo Eckener, commander of the Graf Zeppelin, has selected the American oil, Veedol

Three Planes Test Flown

Reports are received of the test flown of three new planes. These are the four-place Comet powered Model M 3 high-wing cabin monoplane turned out by the Maximum Safety Airplane Company, Long Beach Calif, the three-place open monoplane developed by Moreland Aircraft, Inc, Los Angeles, a craft with a claimed high speed of 130 m p h, and the "Centurion" three-place LeBlond powered cabin plane manufactured by Century Aircraft Inc, Kansas City.

Named for Ryan Exports

ST LOUIS (MO)—Mahoney Ryan Aircraft Company announces that Steel Inc., Los Angeles has been appointed export representative for Ryan Broughams except in China, Mexico and Canada. Steel, Inc, has agreed to handle 25 planes this year

Mahoney-Ryan, incidentally, recently received an inquiry concerning Ryan Broughams from Ethiopia.

New York Agents Form Organization

Is Air Chamber Section Of Dealers, Distributors

NEW YORK (N Y.)—A dealer and distributors' section of the Aeronautical Chamber of Commerce has now been formed by aircraft representatives of the New York metropolitan area. Committees have been named to study their service, legislative and organization problems with the area within 50 mi of the New York city hall defined to constitute the metropolitan area in which the organization is to extend

George A Vaughn, Jr, was elected chairman of a committee to complete the organization of the special metropolitan area section, with Arthur La Roe and George A. Wies as members

A legislative committee, with J B Taylor, Jr, as chairman, was appointed to represent aircraft dealers and distributors in the metropolitan area in matters pertaining to aircraft legislation effecting them. F W Dalrymple and Earl L House, are the other members.

The service problems facing dealers and distributors including hangar rentals trade in values, initial gas allowance to airplane buyers and deposits required from purchasers, will be studied by another committee. L. M Brown was chosen chairman with George Wies and M D Baldwin as members

Area Representatives Named

Charles L. Lawrance president of the Wright Aeronautical Corporation, presided over the organization meeting as a representative of the Aeronautical Chamber of Commerce executive committee

Dealers and distributors of the area attending the meeting were George A Vaughn, Jr, and B H B Smith, of Eastern Aeronautical Corporation, distributor of Command-Aire and Ryan planes. George Wies, George A Wies, Inc, Stearman distributor, Earl L. House, Inc. D H Moth distributor; Arthur La Roe and James G Adams, of La Roe Airways Eaglerock distributor C R Dann and M D Baldwin, Atlantic Air Services, Inc, Spartan distributor L M Brown, New York Aircraft Distributors Inc, Waco distributor James B Taylor, Air Associates, Inc., Avian distributor, C S "Casey" Jones, Curtiss Flying Service, Inc. distributor of Curtiss, Sikorsky, Cessna and Ireland planes and F W Dalrymple Coastal Airways, distributor of Fairchild planes

Other Distributors

Three other distributors, unable to attend the meeting, became members of the newly formed section. They are L M Rockwell, East Coast Aircraft Corporation Stinson distributor, Thomas Neelands, Travel Air Distributors, fnc and Theodore Lovington, the Addington Aircraft Company, Swallow distributor.

Oklahoma Tour Begins on May 20

Eighteen Cities Listed For Second Annual Event

OKLAHOMA CITY (OKLA)—Plans for the second annual Oklahoma State Air Tour, covering nearly a score of cities over a 1,000 mi. air trail have been completed and final arrangements made for the tour, which starts from Tulsa on the morning of May 20. The tour, under the direction and management of the Oklahoma State Chamber of Commerce, is being promoted to create and maintain interest in aviation in the state, to dedicate new airports, to formulate active plans for new airports and for the general creation of a spirit of air-mindedness among the citizens of the towns visited.

Eighteen cities have already been designated as the itinerary, but two others may be added. The tour will start with 25 official planes of various makes, led by the giant Keystone Patrician. The schedule follows:

May Add Pauls Valley

May 20, Bartlesville, Pawhuska, Blackwell and Enid; May 21, Woodward, Mangum, Lawton and Duncan; May 22, Chicasha, Ardmore, Durant, Colgate and Muskogee; May 23, Okmulgee, Shawnee, Norman and Oklahoma City. Pawhuska, Mangum, Ardmore and Shawnee, respectively, are lunch stops on the tour. Pauls Valley may be an added stop on the fourth day, but no definite decision to this effect has been reached.

Ralph Berry, president of the Oklahoma State Chamber of Commerce, vice-president of the Tulsa National Bank and one of the leading figures in Southwestern air circles, is chairman of the aviation committee, which is in charge of the tour. Mr. Berry has entire charge of direction and formulation of the tour and inspection of airports and planes to be used.

Tentative plans call for Capt. Ira Eaker, famed Army pilot and native Oklahoman as tour commander. B. S. Grahamn, head of the Grahamn Flying Service, operating airports and schools in several Oklahoma cities, is official starter.

Stunting Banned

Strict flying rules are to be enforced on the tour; no prizes are offered, and all Department of Commerce rules are to be enforced. No stunting or outside maneuvers are to be allowed, and only one formation hop is to be made, the final hop from Norman to Oklahoma City.

The tour entries are limited to 25 planes, and an entry fee of $250 is charged for each plane entered. All room and board expenses are met by the towns where overnight stops are to be made. Banquets and ceremonies are scheduled at the majority of these.

An official pilots' dinner is to be held in Tulsa on the night of May 19.

Plan Rochester Aero Display

ROCHESTER (N.Y.)—Building No. 5, formerly used for the automobile exhibit, will be occupied by an aircraft display at the Rochester Exposition in September. William B. Boothby is general manager in charge.

Motor and Equipment Group Surveys Market

NEW YORK (N.Y.)—Just completed and placed in the hands of the Motor and Equipment Association members, *Survey of the Aircraft Market* shows that many automotive wholesalers approximately 350 automotive manufacturers in the membership already are supplying either replacement or original equipment items to the aircraft market. The survey suggests to the parts, accessory, and shop equipment manufacturers ways and means of serving the market.

The survey lists upward of 100 parts, accessory, and supply items and 100 shop equipment and tool items for repair work which are stated to be in common demand at flying fields and also outlines work done and the parts used in typical repair jobs on both air and water-cooled power plants. It follows closely upon the publication by the M.E.A. of its *Buyer's Guide of Aircraft Products*, which listed several hundred aircraft parts, accessory and shop equipment items made by manufacturer members, and the main and branch stores of wholesale members.

Addresses of the Motor and Equipment Association are 250 W. 57th Street, New York; 35 E. Wacker Drive, Chicago; and First National Bank Building, Detroit.

Reduce Siemens to $2,500

NEW YORK (N.Y.)—Price reduction on the Siemens Yankee "7" (SH-14) is announced by K. G. Frank, general representative here of Siemens and Halske, A. G., producer of power units of the 80 hp. to 125 hp. range for American planes. The radial air-cooled Yankee "7," developing 110 hp., was formerly priced at $2,650 but with the new reduction now sells for $2,500 f.o.b. New York City. This engine is being successfully used by Command Aire and the Bourdon Aircraft Corporation, maker of the Kitty-Hawk, the former company having contracted for fifteen of these power plants and the latter, for 25.

Fox Gets Movietone Fokker

NEWARK (N.J.)—"Fox Movietone Air News No. 1," the first aerial sound photography unit, was recently christened here. The plane, a Wasp powered Fokker Super-Universal, carries specially designed equipment for making sound pictures either from the air or ground and with it Movietone men can reach remote sections quickly. Albert E. Holland, war flier, directs the firm's aerial activities.

Bohn Interests Form Simon Appliance Firm

DETROIT (MICH.)—As the second step in his plan announced several weeks ago to make the Heywood Starter Corporation, of which he recently acquired control, the nucleus of an airplane appliance group, Charles B. Bohn, president of the Bohn Aluminum and Brass Corporation, announces the formation of Simon Airplane Appliance Corporation, and the intended formation of the Airplane Equipment Corporation.

Under the announced plans, William B. Stout, president of Stout Air Services, Inc., and Edward Roberts, vice president, in charge of manufacturing for the Packard Motor Car Company, will be on the directorate of the Airplane Equipment Corporation, which concern, upon its organization, will absorb the Simon and the Heywood corporations.

The Simon Airplane Appliance Corporation, it was said, was formed for the purpose of supplying the consolidated corporation with $600,000 working capital. It is understood, also, that the Simon company was formed around a number of airplane appliance patents said to be held by Mr. Bohn. A special meeting of the Heywood stockholders has been called for June 5 in order to ratify a proposal of the directors for consolidating with the Simon company after which the merged firms will operate as the Airplane Equipment Corporation.

The Airplane Equipment Corporation will have an authorized capitalization of 200,000 shares, of no par value, of which 125,000 will be outstanding. Directors of the Heywood company have approved a plan whereby stock of both the Heywood and the Simon companies will be exchanged share for share for that of the consolidated corporation.

National Races Publicity in B-B

CLEVELAND (OHIO)—H. A. Bruno-R. R. Blythe and Associates, public relations counsel, New York, have been awarded the contract for publicity in connection with the 1929 National Air Races and Aeronautical Exposition, to take place here Aug. 24 to Sept. 2, Clifford W. Henderson, air race director announces. J. F. Lanyon is the Cleveland representative of H. A. Bruno and R. R. Blythe. Humphrey & Meredith, of Cleveland, it was further announced, will handle all advertising to be done by the Cleveland National Air Race & Show Corporation. A national and international program to publicise and advertise the events will shortly be undertaken.

Plan Loening Sport Amphibion

NEW YORK (N.Y.)—The Loening plant branch of the Keystone-Loening firm is shortly to bring out a popularly-priced sport amphibion.

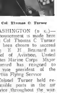
Pioneer Instrument Adding Factory Units

BROOKLYN (N.Y.)—Upon completion shortly of a new addition to the plant of the Pioneer Instrument Company, another wing adding approximately 14,000 sq. ft. of floor space will be started to enable even further expansion, Charles H. Colvin, president of Pioneer, states.

The building now practically ready for occupancy, links two older units to form one complete plant affording 42,000 sq. ft. of floor space for offices and the manufacturing equipment. More than double the former space of 28,000 sq. ft. will have been added upon completion of the new four-story wing and the present link.

By the end of this year, Pioneer, now in its tenth year of business, will have grown from a small plant in the loft of a building on lower Manhattan to an international organization with offices and representatives in all of the world's leading cities and with a manufacturing establishment providing 60,000 sq. ft. of floor space for the construction of navigational and flight instruments.

Heads Marines



Col. Thomas C. Turner

WASHINGTON (D. C.)—Announcement is made here that Col. Thomas C. Turner has been chosen to succeed Maj. E. H. Brainard as Chief of Aviation, United States Marine Corps. Major Brainard has resigned to be vice president of the Curtiss Flying Service.

Colonel Turner held responsible posts in the air service throughout the war. He is in charge of Marine aviation for the second time, having initially held this position early in the decade.

Braniff Buys Central Line

OKLAHOMA CITY (OKLA.)—The purchase of the Tulsa-Wichita airline of the Central Airlines, Wichita, Kan., by Braniff Airlines, Inc., a subsidiary of Universal, is announced by Paul R. Braniff, executive vice-president.

Curtiss Marine Race Postponed Until May 25

WASHINGTON (D. C.)—The annual Curtiss Marine Trophy Race originally scheduled on the Potomac River today (May 18) has been postponed, according to Sen. Hiram Bingham, until Saturday, May 25.

The contest this year will be for service type seaplanes of the Navy and will be over a course totaling 100 mi. The various fliers will be divided into five groups according to the types of planes. As the fastest type probably will complete the 100 mi. in a much shorter time than the scouting or bombing planes, provision has been made for the award by the National Aeronautic Association, with the co-operation of the Hamilton Watch Company, Lancaster, Pa., of five gold wrist watches, each to be given as a prize to the winner of each group.

Thus the contest takes on the form of five distinct races, in addition to the race for the grand prize which is the Curtiss Marine Trophy and which is held at the Navy Department here.

Report 54 Travel Airs Shipped

WICHITA (KAN.) — Officials of Travel Air of Wichita report April as a record breaking business month for their company. During the month the company delivered 54 planes with a total value of $350,000. This approximated the delivery of two planes on each working day of the month. Sixteen six-place monoplanes carrying Wright and Wasp power were delivered to purchasers scattered all over the country. These planes brought in a revenue of $216,000. Twenty-seven of the biplanes delivered were OX-5 powered. The remainder carried Warner, Axelson Challenger and Hisso engines. More than a dozen states were represented in the sales, with two of the planes going to Hawaii and two monoplanes and a biplane going to Canada.

Southern Cross Plaque to Pope

NEW YORK (N.Y.)—On behalf of the Narragansett Bay Regatta Association, the Southern Cross Trophy was presented May 7 in the office of Lorillard Spencer, former president of the Fokker organization. It was won last August by Lieut. L. A. Pope, Scouting Fleet, in a Vought Corsair. The bronze plaque showing the tri-engined Fokker and a map of its course over the Pacific was presented to the Association by Mr. Spencer, and it is now to be competed for annually at Newport, R. I., by land planes, seaplanes, and amphibions.

Kansas Tour Starts From Wichita June 3

WICHITA (KAN.) — Twenty-three Kansas towns will be visited in the second annual All-Kansas Air Tour, which starts from Wichita on the morning of June 3 and returns to this city for a full day air exhibition June 15.

At each of the 23 stops, fliers participating will compete for prizes. Kansas City, Topeka and Wichita will entertain the air armada full days and the other 20 towns will have the fliers there for half days. At the half day stops $500 will be awarded winners in the various air events and $750 will be available at the full day stops. The towns to be visited are offering the money.

Between 25 and 30 planes, carrying from 50 to 60 men and women, will make the trip. The tentative schedule follows: June 3, Pratt in the morning, Hutchinson in the afternoon; June 4, Dodge City and Garden City; June 5, Goodland and Colby; June 6, Norton and Hays; June 7, Russell and Ellsworth; June 8, Concordia and Washington; June 9, Topeka; June 10, Kansas City; June 11, Fort Scott and Pittsburg; June 12, Coffeyville and Independence or Neodesha; June 13, Chanute and Iola; June 14, Emporia and Eureka; June 15, Wichita.

Schlee-Brock Orders Year's Lockheed Output

DETROIT (MICH.) — The Schlee-Brock Aircraft Corporation, Detroit, eastern distributors for Lockheed monoplanes, has purchased one year's output of the Lockheed Aircraft Corporation, Burbank, Calif., it has been announced here. According to the contract a minimum of sixteen planes will be delivered monthly, the entire purchase including a total of 200 planes representing an investment of approximately $3,000,000.

The Detroit corporation has purchased considerable acreage adjoining the city airport and is building a $40,000 hangar on a portion of it. The company also is interested in a new airport being constructed in Plymouth, Mich., near Detroit, and will construct an assembly plant here as soon as that is possible.

Moth Plans Plane a Day

LOWELL (MASS.) — Production of Gipsy Moth planes by the Moth Aircraft Corporation, this city, reached a four per week average for the initial three-month period just closed. Plane-a-day production is to be attained, it is declared, by June 1. Without interfering with volume turn-out in the present straight line unit, an additional unit is now in the course of construction and with this completed the Moth company will have complete facilities. During the first quarter, the Lowell firm has delivered seventeen planes and further more the firm has received contracts for 134 others for 1929.

Parks Air College Orders 72 Planes

Variety of Aircraft For Complete Training

ST LOUIS (MO)—Orders for 72 new planes with an aggregate value of $309,565 have been placed by Parks Air College, Inc, it is announced by Harry P. Mammen, president of the institution. The planes are to be used for training and reserves for the training fleet of Parks Air College, claimed to be the largest flying school with a total of more than 700 students. Placement of the order precedes further announcement of plans for expansion to meet the increasing enrollment.

The new flying regulations, prescribing that students be trained on several different types and that they should have night and cabin plane flying experience before qualifying as transport pilots, is responsible for the variation in types in the orders announced by Mr Mammen.

Thirty-five P-1's, an open biplane with an OX-5 engine, have been ordered for primary training from Parks Aircraft, Inc., an entirely separate corporation with a factory on Parks Airport. Eleven P-2's, biplanes with 150 hp Axelson engines and four P-4's six place, cabin monoplanes with J-6 Whirlwind engines are also to be furnished by the East Side factory.

In addition the order includes twenty OX-5 Travel-Air biplanes, a Whirlwind Travel Air biplane, and two Curtiss Robins. The Robins have already been delivered and are being used for primary instruction in the handling of cabin planes.

Representatives Named

MOTH—Geo. A. Wies, Inc, Garden City, N. Y., for Metropolitan New York District.

GENERAL AIRPLANES—Air Associates, Inc., New York City, Wolverine Flying Service Inc of Lansing, Mich., and Detroit, Mich. for Michigan; Aeroplanes Inc, of Chicago for Illinois and Wisconsin.

PARAGON PROPELLERS—J. E. Menaugh Company, Chicago, for the Central West.

AMERICAN EAGLE—James Holsombach, Meridian, Miss., for that section.

SUPREME PROPELLERS—Stewart Aircraft Company, Cleveland; Fliers Inc, Albany, N. Y., General Airlines, Syracuse, N. Y.; Rochester Fliers, Inc, Rochester, N. Y.; Air Associates, New York City, and L. & H. Aircraft Company, Hartford, Conn.

Haskelite Increases Production

CHICAGO (ILL.)—The Haskelite Manufacturing Corporation's plant has been placed on a 24-hr production basis with the addition of an extra night force needed to meet the present heavy demand for aircraft plywood.

Insurance Case Favors Passenger

DENVER (COLO)—A. G. Gits died about nine years ago as the result of an air plane accident. The lower courts refused to grant his widow the double indemnity, a clause based upon accidental death. The case finally reached the United States Circuit Court of Appeals and that body holds that a citizen who takes an occasional ride in an airplane cannot be classified as one engaged in aeronautical operations. The insurance company may appeal from this decision.

United Makes Quarter Income of $1,816,159.91

SEATTLE (WASH)—W. E. Boeing, chairman of the board of United Aircraft and Transport Corporation, announced last night that the corporation and subsidiary companies for the quarter ended March 31, 1929 reported operating revenues and sales of $5,982,78 with net income after all charges and deductions including federal, and state income taxes, of $1,816,159.91.

No estimate of the full year's earnings of the United is available but it is reasonable to expect that the remaining quarters will be at a higher rate. The equipment companies now have on hand in excess of $12,000,000 of unfinished business, the majority of which is for commercial orders, Mr Boeing said.

The organization details of the United were completed in March, and the first quarter income reflects a substantial amount of non-recurrent organization expense.

Dot Lubricating to Alemite

CAMBRIDGE (MASS)—The line of industrial lubricating equipment bearing the Dot name has been purchased by the Alemite Manufacturing Corporation, Chicago, which will continue its manufacture and sale. The Carr Fastener Company, this city, former manufacturer of this lubrication system, is now concentrating on the production and sale of Dot line fasteners.

Ohio Tube Business Increases

SHELBY (OHIO)—Increased business from the aviation industry is said to have doubled first quarter earnings of the Ohio Seamless Tube Company, this city. Shipments for the period named totalled $1,254,191, an increase of 33 per cent over that time a year ago. Cold drawn airplane tubing is a firm specialty.

MacCracken Heads Avigation Delegation

WASHINGTON (D C)—William P. MacCracken, Jr, Assistant Secretary of Commerce for Aviation, has been named as chairman of a delegation which will take part in an extraordinary session of the International Commission for Air Navigation, opening in Paris June 4.

The International Commission was established by the terms of the Convention of 1919 regulating international air navigation which includes the United States among its signatories although the United States has not as yet ratified it. The purpose of the extraordinary session of the Commission is to consider and discuss amendments to the 1919 Convention. The agenda will be based on an article published last autumn by Dr Alfred Wegerdt entitled *"Germany and the Paris Convention Relating to the Regulation of Air Navigation, dated October 13, 1919,"* which sets forth, in what is understood to be an authoritative manner the German views regarding the desirability of amendments to the 1919 Convention.

The American delegation follows: W. P. MacCracken, Jr.; Joseph R. Baker, Department of State, Technical Advisers: John J. Ide, European representative of the N.A.C.A., Maj. Barton K. Yount, Assistant Military Attaché for Aeronautics, American Embassy, Paris; Lieut. Comdr. William D. Thomas, Assistant Naval Attache for Aeronautics, American Embassy, Paris.

Crouch to Whittelsey Post

BRIDGEPORT (CONN)—R. J. Goodman Crouch, Order of the British Empire and in charge of the investigations on new types of service and civil aircraft in England, has been elected vice-president and chief aeronautical engineer of the Whittelsey Manufacturing Company, Bridgeport, Conn. according to H. N. Whittelsey, president of the company bearing his name. Mr Crouch will sail for this country immediately to supervise construction in the Whittelsey plant of the Avro Avian airplane, for which the American company holds manufacturing rights. Mr. Crouch, one of the most famous designers in England has been the technical aeronautical representative for the British Empire since 1922.

Gates Tests R.S.V. Plane

NEW YORK (N. Y.)—First American tests flights of the R.S.V. Belgian convertible mono-biplane, displayed by the Gates Aircraft Corporation at the Detroit show and now under manufacture by that firm at its Corona, L. I., plant, were made here recently by Capt. Ive McKinney, chief pilot, who tested the craft both as a monoplane and biplane. The demonstations showed the Renard powered plane to have a slow landing speeded as well as a fine stability which the Gates firm says prevents spinning.

Curtiss-Robertson Soon to Make Thrush

ST. LOUIS — (MO)—The Curtiss-Robertson Airplane Manufacturing Co. announces plans for an addition to their plant at Lambert-St. Louis Field to cost between $300,000 and $500,000 for the manufacture of the "Thrush," a six-place monoplane. Work on the new plant, which will adjoin the present factory, is to be started shortly.

The erection of the new factory and the development of the Thrush is part of the expansion program announced for the Curtiss-Robertson Company at a joint meeting of the board of directors at New York last week.

The Thrush will sell for $10,000 and is designed for use by aerial transportation companies. Developed by the Curtiss Aeroplane & Motor Company, it is powered with a Curtiss Challenger engine and is reported to have a high speed of 120 m.p.h. Distribution of the plane will be handled by Curtiss Flying Service, now in the Syndicate Trust Building.

The expansion program, to be voted on by stockholders July 15, calls for the retirement of the 5,000 shares of preferred stock outstanding and the authorizing of an issue of 100,000 shares of no par value common stock. The change is designed to bring $700,000 additional into the company.

Maj. William B. Robertson, president of the concern, is on his way home from China.

Form Illinois Aero Chamber

CHICAGO (ILL.)—The Aeronautical Chamber of Commerce of Illinois has been formed of leading Chicago business and finance men who aim to work for aero development in Illinois. Members of the board are: Laurence H. Armour, president of Aviation Securities Corporation; Leonard A. Busby, a director of the United company; Ralph Hines, John J. Mitchell, Jr., treasurer of N.A.T.; Joseph E. Otis, Jr., director Sikorsky and Aviation Securities; Earle H. Reynolds, of N.A.T.; Lawrence W. Scudder, United Aviation and Gray Goose Air Lines; Harry C. Watts, director United and Great Lakes companies; John Wentworth, of Aviation Securities and Philip K. Wrigley, director of United Aviation.

Connecticut to Buy Corsair

HARTFORD (CONN.)—Connecticut's State Department of Aviation now plans to purchase a Vought Corsair, powered with a Wasp "C." The machine would be used to transport inspectors about the state as well as for traveling purposes of the Department personnel.

Reports Scintilla Production

SIDNEY, (N. Y.)—Scintilla Magneto Company has reached a production schedule of 2,000 magnetos a month at its plant here, according to Thomas Z. Fagan, vice-president.

Report Engine Service Activity

HOLYOKE (MASS)—Precision Cylinder Grinding Company, 563 Liberty Street, reports increased activity in rebuilding and repairing airplane engines. The establishment is conducted by Richard E. Toelken and Herman M. Polley.

Aero Chamber Moving Executive Offices Soon

NEW YORK (N. Y.)—Removal of the executive offices of the Aeronautical Chamber of Commerce from 300 Madison Avenue to 10 E. 40th Street about June 1 is announced by Frederick B. Rentschler, president.

The Manufacturer's Aircraft Association, which has shared offices with the Chamber since 1921 will continue its quarters in the building at 300 Madison Avenue, removing, however, from the seventh to the eleventh floor. This announcement was made by F. H. Russell, president of the association, which dates its founding back to 1917.

The Aeronautical Chamber of Commerce was formally established in 1921, and since that time the two organizations have shared offices. As the industry expanded, the need for larger quarters developed. At the last meeting of the Chamber's board of governors, a committee was appointed to make arrangements for larger executive offices for the Chamber. As a result, the two organizations will hereafter occupy their own offices.

The new offices of the Chamber will provide practically twice the space now available and care for recent expansion of the organization's activities.

International Merger on Coast

LOS ANGELES (CALIF)—Merger of the Albatross Aircraft Corporation, the California Propeller Company, and the Guatemalan Air Service into a $3,500,000 organization is reported here by Sidney W. Neighbors, official of the latter firm. The combination was effected, it is said, to furnish planes for the lines operated by the Guatemalan concern in Central America.

Atlantic Increasing Capital

NEWARK (N. J.)—Directors of Atlantic Air Service, Inc, Newark, N. J., have voted to increase capitalization to $1,000,000 and enter the national field, operating a chain of aviation colleges and airports near principal cities throughout the East. The Chas. Dallas Reach advertising agency, Newark, has been appointed to handle their advertising account.

Time Plan for Bullets

COLORADO SPRINGS (COLO)—It is reported here that through an arrangement with the Motor Finance Trust, the Alexander Aircraft Company will sell its new Bullet model on the time payment plan.

Meets and Displays On Aviation Schedule

Two air meets and an aerial display are planned for the near future, according to reports, with one in the West and two in the East.

According to Mayor Norman A. Boyd, Binghamton, N. Y., an air meet will be held on Bennett Field, that city, during the New York State Mayors Conference, June 19-20. Invitations are being sent to military and civilian fliers for the event. The other meet, a three day event, is planned for the Albany Airport beginning May 30. It will be sponsored by the Fort Orange Post, American Legion.

The display is to be held at the Grand Forks Airport, Grand Forks, N. D., on May 24, when 30 planes from St. Paul, Grand Forks, and other Northwest points will fly in demonstration.

The 30 machines will start from St. Paul on the morning of the 24th, fly to Grand Forks, take part in the activity, then continue to Winnipeg, Man., to participate in the Dominion Day and International Day activity there May 24-25. Grand Forks plans a complete show with Charles "Speed" Holman scheduled for stunt flying.

Winning Balloonists

Showing Lieut. Thomas W. G. Settle, pilot, and Ensign Wilfred Bushnell, his aide, who are credited with first place in the recent National Elimination Balloon Race. They flew the Navy No. 1 from Pittsburgh to Prince Edward Island in this Litchfield Trophy competition which attracted twelve bags.

Stearman Fiscal Year Sales Reach $1,113,000

WICHITA (KAN)—Sales for the past fiscal year of $1,113,000, with a net profit of $65,000 were reported by officers of the Stearman Aircraft Company to stockholders at their annual meeting here last week. Total assets of the company are $450,000 as compared with an original investment in plant, manufacturing and operating equipment of $60,000.

All officers and directors of the company were re-elected with Lloyd Stearman as president. Directors re-elected, besides Mr Stearman, are Mac Short, Harry Dillon, Walter Innes, Jr, J E. Schaefer, G M Brown, G L Henderson, George Siefkin, Jim Davidson, Herbert Steinbuchel, Ralph Middlekauff and Robert C Cross.

It was indicated at the meeting that a new open model is to be built in the near future to carry the new J-6 Wright engines. It also was announced that three of the new cabin craft already have been sold and that ten will be turned out this summer.

Stockholders were informed that two recent offers for mergers had been turned down. The Stearman company is capitalized on a basis of 20,000 shares of stock, 15,000 outstanding. The remaining 5,000 shares are treasury stock and are not for sale.

Gates Receives Three Swallows

NEW YORK (N Y)—Gates Flying Service, this city, has accepted delivery on three Swallow planes, one a three place for passenger and cross country work and two Swallow TP training planes. These will be used by Gates Flying School, Holmes Airport, Jackson Heights, L I, being the first shipment on an order for twelve placed with the Swallow firm at Wichita. Maj W C. Brooks Gates operations manager has had the trainers equipped with Bloxham Safety Sticks and placed immediately in commission.

Aero Building for Los Angeles

LOS ANGELES (CALIF)—Plans have been announced for the construction of an eight-story office and store building on the northwest corner of Eighteenth and Hill Streets, this city, to be known as the Aviation Building. The structure will contain eighty offices and six stores, all especially designed to house aircraft offices and business, and one of the stores is planned without columns to allow for displaying completely assembled planes.

To Display Messer at St. Louis

BIRMINGHAM (ALA)—At the St. Louis show, opening May 25, the Messer biplane, manufactured by the Southern Aircraft Corporation this city, will be displayed to the trade for the first time.

Plans Continental Round-Trip

WASHINGTON (D. C)—Capt. Ross G Hoyt, Army flier, is to attempt a round trip dash from New York to San Francisco within a space of 48 hours, according to reports here. It is said that Captain Hoyt, who piloted the refueling plane when the "Question Mark" established its record, will use a Curtiss Hawk pursuit plane in the flight, planned some time during the period of June 20-25.

Emsco Challenger Nearing Completion

LONG BEACH (CALIF)—Powered with three Curtiss Challenger engines, the first Emsco "Challenger" monoplane is rapidly nearing completion in the Long Beach factory. This craft is a development of the original American Albatross single engined monoplane which was described in detail in AVIATION of Dec. 8, 1928. The present plane incorporates many new features, including a claimed ability to be operated as either a single or tri engined plane and its adaptability to land, seaplane, or amphibion operation.

Emsco aircraft will soon be placed in production in the factory at Dowoey, Calif., this plant now being about 50 per cent completed. The first two tri-engined planes have been purchased by the Emsco Derrick and Equipment Company of Los Angeles, and will be placed in service for the transportation of company executives. E M Smith, president of the various Emsco companies is head of the new Emsco Aircraft Corporation with Charles Rocheville as chief engineer and general manager.

Develop High-Wing Open Plane

CAMDEN (N J)—The "Vimac," a high wing open metal monoplane accommodating two persons, has been developed here by the Victor Metal Aircraft Corporation, 1204 Wilson Building. The machine, which is powered with a Lee engine has been successfully test flown according to reports. The power plant used is a new engine of five cylinders, air-cooled and radial in type, made by Lee Motors, Inc., Collegeville, Pa.

To Deed "Spirit" to Smithsonian

ST. LOUIS (MO)—The "Spirit of St. Louis," is to be formally deeded to Smithsonian Institution, Washington, by Colonel Lindbergh and his St. Louis backers. Although exhibited at the Institution for the past year, the plane has been technically held by the Spirit of St Louis, Inc, organized under a pro forma decree.

Circus at Montague, Mass.

MONTAGUE (MASS)—A four-day air circus was held here May 9-12, with Lieut Carl A Dixon and his squad in possession of the Montague Plains field. A full aerial show was offered.

REVIEWS

Airplane Transportation by James G Woolley, vice-president in charge of traffic for Western Air Express, and Earl W Hill, a lecturer in the Trade and Transportation College of Commerce and Business Administration at the University of Southern California, is a new non-technical work on air transportation, which has been prepared for use as a text book in the schools and also to provide a volume for general reading for those persons who would like to acquire a knowledge of the rudiments of air transportation and its possibilities, even though they are not preparing for a technical career. The book is based on the course of instruction offered at the University of Southern California, and discusses such subjects as the effect of transportation on civilization, the history of airplane transportation, the commercial application of the airplane, types of planes and engines, theory of flight, training personnel, operation and costs, airports and airways, mail, passenger and express service, aviation insurance, meteorology, rates, regulations, investment and speculation. Two of these subjects are discussed in special papers prepared by William P McCracken, Jr., assistant secretary of commerce for aeronautics, and Dr Carl-Gustav Rossby, chairman of the committee on aeronautical meteorology of the Daniel Guggenheim Fund for the Promotion of Aeronautics. The book is published by Hartwell Publishing Company, Hollywood, Calif.

AERONAUTICAL CALENDAR

May 15-26	First International Congress on Sanitary Aviation, Paris, France
May 16-18	Cleveland Airport Convention, Hotel Cleveland, Cleveland, Ohio, under auspices of the Aeronautical Chamber of Commerce.
May 25	Curtiss Marine Trophy Race, Potomac River, Anacostia, D C., under auspices of the Aero Club of Washington, N.A.A.
May 25-June 1	First Annual St Louis Aircraft Show, New Coliseum, St. Louis, auspices Jackson Johnson Post No. 72, American Legion, Headquarters Hotel Chase
May 27-30	American Society of Mechanical Engineers, National Aeronautic Meeting, Hotel Jefferson, St. Louis
May 27-June 2	Indianapolis Aviation Show of the Indianapolis Aircraft Association, State Fair Grounds
May 28-30	Gardner Annual Trophy Race, St. Louis, Mo.
June 10-14	First Michigan Air Tour Starting at Pontiac Municipal Airport.
June 27-30	International Light Plane Meet, Amsterdam, Holland
July 16-27	International Aircraft Exhibition of the Society of British Aircraft Constructors, Olympia, London
Aug. 24-Sept. 2	National Air Races and Aeronautical Show, Cleveland, Ohio
Aug 26-28	Society of Automotive Engineers, Cleveland Aeronautic Meeting.
Sept. 6-7	Schneider Cup Race, over the Solent, Cowes, England.
Sept. 28	Gordon Bennett Balloon Trophy Race, St Louis, Mo
Oct. 12-27	Southwestern Aircraft Exposition, State Fair Grounds, Dallas, Tex
Dec 1-9	International Aeronautical Exposition of the Aeronautical Chamber of Commerce, Chicago

PERSONNEL

Dan W. Jones, of St Louis, has been elected president of the Universal Aviation Corporation. Louis H Piper, former president, has become chairman of the Board.

Maj. E. H. Brainard has resigned from the Marine Corps to become vice-president of the Curtiss Flying Service.

Lieut Daniel Kearns, formerly of Lowry Field, Denver, Colo, has become affiliated with the North American Aircraft Corporation. Lieut Vic Beau has taken Kearns' place.

Maj Thomas Lanphier formerly operations manager of T.A.T., has been appointed vice-chairman of the Technical Advisory Committee. Other T.A.T. changes include Paul Collins, general superintendent, John A. Collings, and Max Cornwell, assistant general superintendents in charge of the eastern and western divisions, respectively, Henry W. Conner, eastern traffic manager, J. W. Brennan, central traffic manager, and Harris W Beck western traffic manager.

Comdr. John H Towers has been appointed assistant chief of the Navy Bureau of Aeronautics.

Milford D. Sater of St. Louis and Lloyd L. Juelson of Memphis have been appointed instructors in the Robertson division of Universal Aviation Schools.

Walter Trepz has been appointed engine instructor in the night school of the Robertson division, Universal Aviation Schools.

Hubert Rueschenberg has been appointed pilot on the St Louis-Kansas City line of the Robertson division.

S A Stimpson is now San Francisco traffic manager of the Boeing System. K K Knickerbocker is Chicago traffic manager, H W Peterson Omaha traffic manager, Russel Ahrens, Oakland traffic manager, Lee Jamison, Portland traffic manager, George Strehlke, Seattle traffic manager, and A J Kinsman passenger traffic manager. W A. Patterson is general traffic manager with headquarters at Salt Lake City.

Lieut Howard Littlefield has been ordered to the ground school staff of Parks Air College.

J von der Heyden has been appointed assistant to the vice president in charge of sales promotion of the Consolidated Instrument Company of America, Inc.

G H Watkins of Cambridge, Mass., and Neil E Buckley of Tacoma, Wash have joined the staff of pilots of Massachusetts Airways Corporation, Springfield, Mass.

Capt Louis R. Knight on leave of absence from the Army Air Corps, is to be an instructor at the Goebel Flying School, Kansas City. Lieuts Harold Wheaton, Alva L. Harvey, Harvey F Dyer, Carl J Crane, H. H. Hollan, W. R. Carter and James A. Mollison are reported among those who are to teach at the school also while on leave from the Army.

Hans A. Feldmann has been appointed general manager in charge of sales, service and taxi business and ground, mechanics and flying schools of the Weeks Aircraft Corporation, Milwaukee, Wisconsin.

Myron S Hutchinson, formerly with the General Aviation Company, Inc, Syracuse, N Y, has been appointed in charge of airplane sales for Air Associates, Inc., New York, N. Y.

William E Berchtold, aviation editor of the Associated Press, has been appointed the manager of the information section of the Aeronautical Chamber of Commerce.

Allen Quinn of Kansas City, Mo., has been appointed Associated Press aviation editor.

Lyman H Johnson has been appointed assistant to Clifford W. Henderson in the direction of the recently created aircraft show section of the Aeronautical Chamber of Commerce.

Forrest E Kelch, formerly with the Shockley Flying Service, South Bend, Ind., has joined the staff of pilots of the Thompson Aeronautical Corporation.

David Mitchell, formerly of the Bach Aircraft Company, has joined the staff of the Pickwick Airways, Glendale, Calif, as general superintendent of operation.

Donald Hall has joined the staff of the Maximum Safety Airplane Company, Los Angeles.

E. T Walter, formerly with the Travel Air concern has joined the field staff of the Coffman Monoplanes, Inc, Oklahoma City.

L. M. Matthews, formerly with the Coffman Monoplanes, Inc, has joined the ground staff of the Southwest Air Fast Express Company in Oklahoma City.

Allan Olson, pilot on the Braniff division of the Universal Air Lines, has been transferred from Oklahoma City to the Tulsa office of the organization.

Maj Roland A Laird has been appointed manager of the new department of aviation, Dallas Chamber of Commerce.

Milton Carlson, Jamestown, N Y., has been appointed chief instructor for McCray Air Services, Fairview, Pa.

John L. Moran, formerly Federal inspector in Pennsylvania, Virginia, Delaware and the District of Columbia has been transferred to the New England division.

T. C. Peiffer of Keota, Ia., a graduate of Mid-West Airways School at Monmouth, Ill, has taken over operation of the Cedar Falls, Ia, Airport. Arden Livingston, former operator, has returned to the Waterloo airport.

Robert Lehman, chairman of the executive committee of the Aviation Corporation, William B Stout, W. W Crocker, vice president, Crocker First National Bank of San Francisco, and Seymour H Knox, vice president of the Marine Trust Company of Buffalo, have been made directors of Air Investigators, Inc.

Charles F. Willard Los Angeles, Calif, has become identified with the Aircraft Finance Corporation of America.

Lieut Comdr. Paul E Gillespie of Universal Aviation Schools has been appointed commander of the St Louis Naval Aviation Division.

Wilford Gerbracht is chief pilot for H L Ogg, washing machine manufacturer of Newton, Iowa.

J R Green has been elected president of the Oklahoma City chapter of the National Aeronautical Association.

John P Worthington has been promoted from Federal associate airways engineer to airways engineer with headquarters at Portland, Ore.

Robert H Gray has become assistant to Tom Hardin, general manager of Southern Air Transport.

L. Bowman Coon, formerly of the Sperry Gyroscope Company, has been appointed factory superintendent of the Pioneer Instrument Company.

Harry L. Dangler New York City manufacturer, has been elected director of the Gates Aircraft Corporation.

Harold Queen, flying instructor at Rockwell and March Fields during the war, will be instructor in the ground school and aerodynamics course to be started at the University of Akron this fall.

TRADE TIPS

It has been reported that

M D. Carmichael, Citizens Bank Bldg., West Palm Beach, Fla, will erect hangars and a service station at the Belvidere Park Airport, and a flying school will be in operation before winter.

The Texas Aero Corporation, of which George W Williams is president, Temple, Tex, is reported planning to erect a large manufacturing plant in Dallas, Tex., with a branch in Temple.

Moncton Airport, Ltd, Moncton, N. B. plans to build a chain of airports and deal in aircraft.

State Aviation Commissioner Clarence M Knox of Connecticut is receiving bids for the proposed $25,000 departmental administration building to be built at Brainard Field.

W R Ramsey, Oklahoma City, is planning to build a private airport in connection with his country home.

The Tampa, Fla, Flying Club plans to buy two planes for preliminary instruction purposes.

Union Airways Company, Spokane, Wash, is to build a 100x200 ft hangar at the municipal airport.

[See also story on airport construction projects—Ed]

BRIEFLY

An air carnival is being planned by Taylor Brothers Aircraft Corporation, Bradford, Pa., the latter part of May to observe the opening of its new factory.

Shipments of helium from the government's new plant near Amarillo, Tex., started May 6.

The first section of a $200,000 plant for the production of the Panther L-head engine has been completed for the MacClatchie Manufacturing Company.

Braniff Airlines recently took delivery of three Fairchild "71's".

F. Trubee Davison, assistant secretary of war for aeronautics, is making a tour of military fields as far west as the Pacific Coast, using a Fokker transport.

Aviation features and programs intended to foster international good will are planned by Station WRNY, New York City, the aviation radio station backed by the Curtiss-Keys group, which recently applied for six short waves for relay broadcasting.

Mrs. Keith Miller, Australian woman pilot, has arrived in this country. She praised the Avro Avian which she used in a flight from London to Australia with Capt. W. N. Lancaster.

Prospecting for $30,000 worth of black diamonds started when the plane carrying them crashed after the pilot was forced to jump with his parachute. All but 30 of the 133 stones were retrieved from the soil.

About 100 inquiries are being received daily by the American Eagle Aircraft Corporation in connection with its nationwide advertising campaign, it is reported.

A. L. Greene & Associates announce a change of address from 11 West 42d St., New York City, to Grand Central Terminal, Suite 1735.

A new rivet display and sample card has been prepared by the National Rivet & Mfg. Company, Milwaukee, Wis.

The problem of commuting 3 000 mi. between Los Angeles and Detroit, Mich., led to the purchase of a Waco 220 by Dick Dodds, who has residence and business interests in the two cities.

It has been reported in Springfield, Mass., that Charles A. Levine and his associates have bought the Indian Motocycle plant for the manufacture of aircraft engines.

Plans for the formation of a $3 000 000 airplane manufacturing and transport corporation are expected to be completed at Montgomery, Ala., in June.

A memorial to Baron von Huenefeld in the shape of a bronze plaque has been presented to the city of New York by the German societies of New York City.

A bill allowing $4,529,354 for the Air Corps and for a five year expansion program has been introduced in Congress.

Actual tests in landing and dispatch of airplanes on dirigibles in flight are expected soon at Lakehurst, N. J., following a series of experiments by the Navy.

Boeing System reports that banks and financial houses are using air mail and express more now following the introduction of the Night Transcontinental.

Senator J. Griswold Webb, a chairman of the New York State Aviation Commission, is making a nation-wide survey of airport and airway systems by air.

Sales of Stinson planes totaled $153 004.65 for April, 1929, as compared with $66 278.53 during April, 1928.

American Airports Corporation, chartered in Delaware, has applied for permission to do business in New York.

Parks Air College will furnish the convoy plane to be used by the Elks in their cross country trip to the national convention at Los Angeles.

The Osage Aircraft Company has been organized at Pawhuska, Okla., and a factory is being built for the production of a small low powered plane to be called the "Papoose."

A course in general aeronautics is now being offered students of the Colorado College, Colorado Springs, Colo.

Plans are on foot to organize in the fall an aviation section of the Society of Automotive Engineers at Wichita, Kan.

Three new courses have been added by the Guardian Air College of St. Louis.

Production is expected to begin soon on the new four place American Eagle cabin monoplane.

Continental Oil Company, Denver, Colo., is air marking landmarks along the Pueblo-Cheyenne air mail route.

The Technology Club of Central Ohio will sponsor a scholarship in aeronautical engineering at the Massachusetts Institute of Technology.

Wichita, Kan., is to be one of the control points on the first women's air derby to be run in connection with the national air races at Cleveland. The derby will start at Los Angeles.

Topeka, Kan., and Bartlesville, Okla., have been made intermediate stops on the Kansas City-Wichita and Wichita-Tulsa lines respectively, of the Central Air Lines Company.

A medal of honor was awarded the Airmap Corporation of America, Brooklyn, N. Y., at the International Aerial Photographic Salon, Paris, France.

New city ordinances at Oklahoma City require planes to fly at an altitude of at least 2 000 ft. over the city.

A twenty-year lease has been granted the Atlanta Aircraft Corporation for a four-acre tract on Candler Field.

Stevens Point Airways Corporation, Stevens Point, Wis., has leased the Mosinee Airport.

During its second year of operation just ended, Mills Field, San Francisco, experienced a gain of 525 per cent in flights made and 600 per cent in passengers carried over the first year.

On April 20 the Boeing System completed its first 5,000 000 mi. of flying, it is announced.

Passenger business of the Western Air Express is reported to have more than doubled since its excursion rates went into effect January 1.

An average of six passengers per trip has been carried by the Colonial Air Transport, New York-Boston line, during its first two weeks of operation.

Two German glider experts are to come to this country for the glider school on Cape Cod, Mass., under auspices of the American Motorless Aviation Corporation.

The Oakland Flying Club, East Bay Flying Club, United Flying Club, Rainbow Flying and Oakland Police Aero Club are operating at Oakland, Calif., airport.

Detroit Aeronautic Products Company is reported to have been organized with $25,000 for the manufacture of aeronautical appliances.

New Firms Announced

MONROE FLYING SERVICE INC., Rochester, N. Y., capital $40 000, by William G. Marx, 215 Lark St., Rochester, Oscar B. Wegman, Howard F. Nenno, Gregory F. Mills, to operate aircraft.

AIRCRAFTERS INC., Monroe County Airport, Stroudsburg, Pa., Lieut. Bert Clarke president and general manager, R. Spotswood Pollard, vice-president and executive director, to engage in general flying activities and to operate the Monroe County Airport.

AMERICAN BRITISH AIRWAYS, INC., 1 Broadway, New York City, capital 300 000 shares non par value stock, Nathan Lieberman managing director, to engage in general aviation business.

TIMM AIRCRAFT CORPORATION, Glendale, Calif., capital stock $600 000, by O. W. Timm, D. Pope and Caroline Timm, of Glendale and Irene Timm and Fred E. Subith of Los Angeles.

SKY ROAMERS, INC., Racine, Wis., to engage in the business of selling and operating airplanes, operating from Air City, the airport of Racine.

WEST COAST AIRCRAFT CORPORATION, Los Angeles, Calif.; capital stock of $200 000, by Don Crow, C. H. Schmuck, E. W. Schmuck and Bert F. Wade.

FEWEL FLYING SERVICE, Lewiston, Iowa, by A. A. Schockelton and Pearl Dye, to engage in the commercial aviation business.

UNITED UNION AIRWAYS, INC., Spokane, Wash., capital of $100 000; by W. R. Frentzel, Francis Baker and C. M. Baker.

BOYER AIRPORT COMPANY, Newport, Ky., by Albert S. Boyer, of Alexandria, Ky., and others, to conduct an office in Newport with a landing field near Ross, Ky., on the Ohio River.

AIRPORTS AND AIRLINES

Pacific Airship Service Proposed

NEW YORK (N. Y.)—Definite plans for a dirigible service connecting this country with Hawaii and the Orient were announced here recently by Paul W. Litchfield, president of the Goodyear Tire & Rubber Co., and the Goodyear-Zeppelin Company. The company is said to be ready to go ahead with the expenditure of at least $10,000,000 on the proposed line if it can be assured government mail contracts to assist in the concern's operating finances.

To secure this Government mail aid, Mr. Litchfield outlined the plans to President Hoover May 9 in company with Senators Fess, Burton and Bingham, who are interested in assisting the project from the government angle. It was said that President Hoover expressed sympathy in the project.

The airships would be operated at first between the Pacific Coast and Hawaii on a 36-hr. schedule. Only mail would be carried at the outset but the passenger service probably would be added after the first nine months. Congressional approval of support cannot be secured at the earliest until December, it is said. The company hopes to secure approval soon so that the first of the two proposed commercial airships may be laid down simultaneously with the two new Navy airships which the Akron concern is to build.

The first airships would be launched in the spring of 1931, followed fourteen months later by the second if plans go through. One ship would cost about $5 000 000 and two a total of about $8,000,000. The company plans to extend the line to the Philippines and Australia and other points in the Orient as soon as practicable.

Competition in the scheme is promised by the report that John A. Elden, Cleveland attorney, has been retained in a project which contemplates buying the German Graf Zeppelin for service between Los Angeles and Honolulu. Dr. Herbert Schatam of Berlin has been in Cleveland and Chicago pushing negotiations in the scheme.

Barnes & Gorst Low Bidder

SEATTLE (WASH.)—Barnes & Gorst Air Lines, Inc., submitted the lowest bid for the contract to carry air mail between Seattle and Victoria, B. C., for the next four years. It is the present holder of the contract for this 76-mi. route. Barnes & Gorst bid was $.76 per mile. Other bids were Boeing Air Transport, Inc., $.80 per mile and Allied Aviation Industries, Inc., of St. Louis, Mo., $1.85 per mile.

To Honor Harry Brooks

PONTIAC (MICH.)—The new local municipal airport is to be dedicated about the middle of June to the memory of Harry Brooks, well known test pilot of the Ford company.

Appoint Airways Supervisory Group

WASHINGTON (D. C.)—The following have been appointed to the Inter-Departmental Committee on Airways suggested by President Hoover to hear and determine questions relating to the extension of the civil airways system of the United States: W. Irving Glover, second assistant postmaster general, Chase C. Gove, deputy second assistant postmaster general, and E. B. Wadsworth, superintendent, air mail service, for the Post Office Department, and William P. MacCracken Jr., assistant secretary of commerce for aeronautics, F. C. Hingsburg, chief, airways division, and Harry H. Blee, chief, airports division, for the department of commerce.

Hearings will be held from time to time to hear various opinions and suggestions relative to the establishment, extension or modification of the airways system. The first of these has been set for May 22 at the Post Office Department regarding an airway between Pittsburgh and Norfolk by way of Baltimore and Washington and another connecting Pittsburgh, Philadelphia and New York. On May 23 a hearing is scheduled relative to an airway from Richmond or Greensboro to Jacksonville, Fla., by way of Winston-Salem, High Point, Raleigh, Columbia, Augusta, Savannah and Charleston. On May 24 an airway from Pasco, Wash., to Seattle, Spokane, Portland and Tacoma will be considered.

Mail Rate Conference May 27

WASHINGTON (D. C.)—The readjustment of rates and the renewals of contracts will be discussed by air mail contractors who have been invited by W. Irving Glover, Second Assistant Postmaster General, to confer in Washington, Monday, May 27. All operators of air mail routes are expected to attend this annual meeting, which usually has been held in Chicago.

Compile Marking Data

WASHINGTON (D. C.)—Methods of airmarking instructions to air navigation, approved by the Army, Navy and Aeronautics Branch, have been prepared and are available at government offices.

Curtis Airports Concern Organized

To Operate National Chain of Flying Bases

NEW YORK (N. Y.)—Curtiss Airports Corporation, said to represent the latest move of the Curtiss-Keys interests to establish a national network of airports and airlines closely co-ordinated with railroad systems, has been announced here. The corporation was organized under the Delaware laws to acquire and operate either directly or through subsidiary and affiliated companies a chain of airports, strategically situated near leading cities, including under the present plans, such centers as New York City, Chicago, Philadelphia, Baltimore, Louisville, Cleveland, Pittsburgh, St. Louis, San Francisco and Los Angeles.

To carry out its projected developments and purchases in the above ten areas the concern has offered 2 500 000 shares of capital stock at $12.50 per share out of the total of 5,000 000 shares which have been authorized. These shares have been offered through a group of well known financial concerns. Other cities will be brought within the scope of the concern as its operations expand.

Has Broad Charter

While its primary attention will be directed to airport development and operation, the corporation may under its charter, engage in all other forms of flying activities and the manufacture of aircraft engines and accessories. It will in no way take over any activities of the Curtiss Flying Service or affiliated companies, however, it is reported. The two units will be directed by much the same interests, of course, but they will be maintained as entities and their activities merely be coordinated. In fact, Curtiss Flying Service officials are credited with the selection of the sites chosen for acquisition after considerable survey work.

Although the company states that it has arranged to acquire these sites, it reserves the right to substitute others if for any reason the proposed plans do not mature in any part. It is proposed that all these airports will be owned in fee simple with the exception of certain minor leasehold interests. Construction will be under the general supervision of the Stone & Webster Engineering Corporation and Charles M. Franzheim & Company, architects.

The thirteen airport sites already planned for in ten cities are:

(Concluded on Page 1710)

Report Additional Airport Construction

Development Work Continues in Many Places

The Embry-Riddle Co., Cincinnati, has secured an option on a tract of land west of Chesapeake, Ohio, opposite Huntington, W. Va. Here it will construct an airport to serve Huntington, Ashland, Ky., Ironton, Ohio, and other communities in that section. The work will start June 1 to be completed within three months. Several Akron, Ohio, rubber companies are reported considering plans for uniting in the erection of a large hangar at the Akron Municipal Airport to house planes operated by the companies.

Robertson division of Universal Aviation Corporation is building a steel hangar at the Lambert-St. Louis Field in which OX-5 engines, being received for overhauling, will be stored. Recently eight carloads of these engines were received from the Curtiss company. Garland Aircraft Corporation is planning to build the third major airport at Tulsa, Okla., on a 160-acre tract southeast of the city on what is known as the Broken-Arrow Highway. It is reported that about $250,000 is to be spent on the field, hangars, student accommodations and administration building. The Cleveland School of Aeronautics and the Mid-Continent Airways will be located there in addition to the Garland concern.

Jersey City Port Started

Plans are said to be under consideration at Oklahoma City to move flying schools to another field to eliminate the overcrowded conditions pending the proposed enlargement of the present airport area. The Jersey City Airports, Inc., is starting construction of a combined land and seaplane airport at Dovers Point, Newark Bay. The company has a 25-year lease from the city. It is near the Crescent Airplane factory in which Clarence Chamberlin is interested. The Board of Aldermen of New Haven, Conn., have been asked to authorize a $325,000 bond issue with which to purchase the Morris Cove airport site, grade the land and prepare two runways. It is expected that action on the bonds will not be completed before July. This plan follows considerable discussion of various aspects of the problem.

Hornell Airways, Inc., is to spend $10,000 for improvements in the hangar at its Hornell, N. Y., airport. Texas Air Transport, Inc., has acquired its own airport in the vicinity of the Fort Worth, Tex., Municipal Airport. Improvements to cost $10,000 are reported underway at the Des Moines, Ia., Municipal Airport by Yellow Cab Airways, Inc. Construction of a building for overnight accommodations is included. The Curtiss Flying Service has started its $250,000 building program at Fairfax Airport, Kansas City, and construction is at present being pushed rapidly.

Steel framework for the main plant building of the air terminal of American Aeronautical Corporation on Manhasset Isle near Port Washington, L. I., has been started. This is to be an extensive seaplane terminal and manufacturing plant costing altogether about $1,500,000. Following approval of the Minnesota legislature of its request to sell $450,000 in bonds, Minneapolis is now able to proceed with its plans to increase the Wold-Chamberlin Field from 325 acres to 565 acres and make improvements to include a municipal terminal building, concrete apron and other developments.

Studying Candler Field

William F. Center of the Aeronautics Branch has been detailed to study present facilities and possibilities of Candler Field, Atlanta, Ga. His recommendations will form the basis for improvements in the next two or three years. The Government of Panama is seeking an airport closer to the capital than the present Lindbergh Field, seven miles from the city. Negotiations for suitable space are in progress. It appears that the New Orleans Levee Board has won its fight to issue a permit authorizing construction of the new proposed airport on Lake Pontchartrain. Vigorous protest to this action had been made over several weeks by summer residents on the lake, and others.

It is reported that the new plans for the $1,000,000 hangar at the Detroit Municipal Airport have been approved by the city's special committee. The matter goes to the city council for action and its approval is expected to rest upon assurance from the government that the present airport is capable of being developed into an A-1-A project.

Airports have been opened recently at Pierre, S. D., Havre, Mont., Sheridan, Wyo., Benton Harbor, Mich., Iola, Kan., Mangum, Okla., Corsicana, Tex. The Fitzmaurice Flying Field at Massapequa Park, L. I., was opened May 12. This field is named in honor of Col. James C. Fitzmaurice, pilot of the Bremen. It is planned as a convenient field for airplane commuters to New York City.

The Aeronautics Branch reports the following are planning municipal airports:

Angels Camp, Calif., Montezuma, Ga., Dixon, Ill., La Harpe, Ill., Murphysboro, Ill., Goshen, Ind., Kokomo, Ind., Brewster, Kan., Colby, Kan.; Lafayette, La., Worcester, Mass., Boyne City, Mich., Duluth, Minn., Yazoo City, Mo., Kansas City, Mo., Bloomsburg, Pa., Chester, Pa., Clearfield, Pa.; Greenwood, S. C., Gregory, S. D., Clarksburg, W. Va., Appleton, Wis.

W.A.E. Completing New Line

LOS ANGELES (CALIF.)—Operation of its tri-engined Fokkers over the proposed passenger service to Kansas City on or about June 1 is confidently expected by Western Air Express officials.

Stout Speeds Up Cleveland-Detroit Service

CLEVELAND (OHIO)—A reduction in running time between Cleveland and Detroit from 100 min. to 90 min. was announced for May 15 by the Stout Air Lines, Inc. The company also announced that the departure time of the morning planes on the Cleveland-Detroit division has been changed from 9:15 a.m. to 8:45 a.m., and that a morning schedule has been added on the Chicago-Detroit division under which a plane will depart from Detroit at 8:30 Eastern Standard Time, and from Chicago at 7:30 Central Standard Time.

The afternoon schedule on this division has been altered, and the Chicago-bound plane will leave Ford Airport at 4 p.m. Eastern Standard Time, while the eastbound plane will depart from Chicago at 3 p.m. Central Standard Time.

Colonial Cuts Running Time

NEW YORK (N.Y.)—Fifteen minutes have been cut off the running time between airport terminals on the Colonial Air Transport New York-Boston passenger service. This reduces the total time for the trip between the Hotel Pennsylvania here and the Hotel Statler, Boston, to three hours.

(Continued from page 1709)

Greater New York. The new Curtiss Airport now being constructed at Valley Stream, L. I., New York Air Terminals, Inc. which is being constructed at Secaucus, N. J., Hadley Field, at New Brunswick, N. J., and bases for sea planes and amphibians to be constructed at North Beach and Flushing and Bowery Bays, Marvin Airport which will be constructed at Fairfield, N. J.

Chicago. Reynolds Airport in the Glenview district near Chicago.

Philadelphia. Central Airport at Camden, N. J., Main Line Airport, which will be constructed at Paoli, Penn., about 18 mi. west of Philadelphia.

Baltimore. Baltimore Airport, which will be constructed near Druid Hill Park bordering on the city limits of Baltimore and situated on the main air line extending from New York to Washington, D. C., and other southern cities.

Louisville. Willisae Airport, which will be constructed on the North side of the Ohio River directly across from Louisville.

Pittsburgh. Bettis Airport, about 8 mi. south of Pittsburgh.

Cleveland. Herrick Airport, which will be constructed in the Gates Mill suburban district.

St. Louis. Steinberg Airport, which is under construction.

San Francisco. Alameda Airport, which is situated at the Alameda Mole, opposite the foot of Market Street, San Francisco.

Los Angeles. Grand Central Air Terminal, at Glendale, Calif.

The officers include: C. M. Keys, chairman of the board; Walter S. Marvin, president. The board of directors will consist of the following: Roger Amory, Lawrence H. Armour, R. H. Berry, James P. Butler, George H. Calvert, R. D. Chapin, Howard E. Coffin, J. Cheever Cowdin, W. R. Crawford, Jr., C. W. Culbris, George W. Davison, Donald W. Douglas, Thomas W. Dysart, Thomas R. Eastland, Earle P. Halliburton, Paul Henderson, Charles S. Jones, Leonard Kennedy, E. A. Landreth, John J. Mitchell, Jr., C. C. Moseley, Jansen Noyes, Allen K. Owen, F. Le Moyne Page, E. A. Pierce, C. F. Roeser, Frank H. Russell, W. V. C. Ruxton, D. M. Schaeter, A. Charles Schwartz, J. A. B. Smith, C. C. Spicer, Mark C. Steinberg, Harold E. Talbott, Jr., Eugene E. Thompson, Roy E. Tomlinson, Eli T. Watson and James C. Willson.

Bollam Describes Pacific Coast Service

PORTLAND (ORE.)—Airplane passenger service along the Pacific Coast from Victoria, B. C., through Portland to San Francisco will be inaugurated July 1 by the Bollam Air Transport Company, according to annoucement made May 4 by Richard E. Bollam, formerly of West Coast Air Transport Company, who stated incorporation papers for the new company are to be filed at once. Sixty per cent of the company's 25,000 no-par shares have been subscribed, and the rest is to be placed on sale. The company's headquarters are to be in Portland and will use the Swan Island Airport as its terminal.

Initial service will consist of two round trips daily to Boeing Field, Seattle, and one to the Alameda Airport on San Francisco Bay, Bollan says. Ford planes accommodating fourteen passengers and two pilots will be used and are scheduled to negotiate the Seattle run in $1\frac{1}{2}$ hr. and to San Francisco in $4\frac{1}{2}$ hr. Later it is expected that the company will make three or four trips daily to Seattle and two to San Francisco, and that the company's coastwise schedules will tie in with lines south and east from San Francisco.

Toy Balloons Show Ceiling

WASHINGTON (D.C.)—Toy balloons are now taking their place in aviation. F. C. Hingsburg, Chief Engineer of the Airways Division of the Aeronautics Branch recommends them for determining the ceiling at landing fields. The toy balloons are inflated with hydrogen to the point where the balloon will support a weight of 40 grams. The rate of ascension is about $5\frac{1}{2}$ f.p.s. The balloon is liberated and a stop watch is used to determine the time elapsing until it disappears in the clouds. These balloons may be used frequently on account of the low cost as compared with the regular pilot balloon which is used at only certain intervals.

P. & W. Buys Own Airport

HARTFORD (CONN.) — Following acquisition of an option on 500 acres near the Connecticut River in East Hartford, the Pratt & Whitney Aircraft Corporation has announced plans for building its own airport. At present the company has a large hangar at Brainard Field, which is directly across the river from the new development. The extent of the company's activities to be carried on there has not been disclosed.

To Study Airport Surfacing

WASHINGTON (D. C.)—A study of types of materials suitable for airport surfacing is to be made by a recently appointed committee of the American Road Builders' Association. Maj. D. A. Davison of the Corps of Engineers has been named as chairman.

Will Auction Space for Hangars

SYRACUSE (N. Y.)—Space for commercial hangars will be auctioned off here at 10 a.m., May 29, the minimum price to be accepted being $.03 a foot for plots of 5,000 or more square feet. The leases will run for five years. Under tentative plans it is expected that Colonial Western Airways, General Aviation Company and Curtiss Flying Service will take 60,000 sq.ft., 19,200 sq.ft., and 15,000 sq.ft., respectively.

Hundreds Gather For Airport Meeting

CLEVELAND (OHIO)—As AVIATION goes to press hundreds of those interested in various aspects of airport design, construction and operation are assembling here for the first national airport convention under the auspices of the Aeronautical Chamber of Commerce. Profiting by many of the mistakes which cropped out during the development of railroad facilities, the airport men are seeking as far-sighted policies as possible in airport matters. The problems are considered particularly pertinent now.

Whether or not cities should permit roof advertising, whether heavy transport planes should land at mid-city airports or have their terminals at outlying fields furnishing shuttle taxi service to the city, and such problems, are due to come before the convention. Attention is to be directed to the esthetic as well as the practical side of airport construction.

Hartford to Get Radio Service

HARTFORD (CONN.)—The Federal Radio Commission at Washington, D. C., has granted licenses and permits to the Colonial Air Transport, Inc. for the construction of experimental airplane radio stations here. Lieut. Herbert H. Mills, manager of the Brainard Field, has received word that the superintendent of lighthouses in Detroit had been asked to ship one intermediate frequency radio receiver with complete equipment to the local station. This means that Hartford will receive hourly weather reports from Hadley Field, N. J.

Ideco Blinker Tower Pictured

Blinker towers and tank houses such as pictured on page 1627 of the Airports and Airlines section of AVIATION last week are of the Ideco line manufactured by the International Derrick and Equipment Company, Columbus, Ohio.

St. Louis Airport Commission Named

ST. LOUIS (MO.)—Mayor Miller of St. Louis has appointed the five civilian members to the City Airport Commission to serve with five city officials in an advisory capacity in the construction and management of the $2,000,000 municipal airport at Lambert-St. Louis Field.

The five men are: Harold M. Bixby, chairman of the board of the Chamber of Commerce; Stanley Clarke, president of the Public Service Co.; M. E. Holderness, vice president of the First National Bank; Frank K. Harris, vice-president of the Lafayette South Side Bank, and A. S. Werremeyer, member of the Board of Education and the Citizens' Bond Issue Supervisory Committee.

A recent ordinance authorized the Airport Commission, which replaces a temporary commission. The chairman of the new body is the Director of Public Welfare; the other city members being the Park Commissioner, the Comptroller, City Counselor and President of the Board of Aldermen.

The commission has appointed two firms of airport designers, Love-Sultan, Inc., and B. Russell Shaw, to advise city engineers on the airport improvements authorized under the $2,000,000 bond issue. The group has power to appoint an airport manager at a salary of $3,000 a year.

The most important work so far accomplished by the city at Lambert-St. Louis Field has been the installation of a temporary lighting system for night landings and the waging of a clean-up campaign including the removal of trees that are flying hazards.

Airship Base Board Named

WASHINGTON (D. C.)—The naval board authorized by Congress to select the site for the Navy's airship base on the Pacific Coast has been appointed and will convene at once. The Board will include Rear Admiral William A. Moffett, chief of the Bureau of Aeronautics; Rear Admiral Joseph M. Reeves; Comdr. Garland Fulton, in charge of the lighter-than-air division of the Navy; Lieut. Comdr. Charles E. Rosendahl, who is in charge of rigid airship training and experimental squadrons, and Lieut. Comdr. E. L. Marshall. The investigation will be confined to the Los Angeles-San Diego area.

Pacific Coast Has 325 Fields

SAN FRANCISCO (CALIF.)—There now are 325 airplane landing fields on the Pacific Coast according to the new directory just issued by the Standard Oil Company of California. This is an increase of 60 new fields since the previous edition was published in June, 1928. Southern California has 84 landing fields as compared to 64 last June. Rapid improvement in airport facilities is noted in the guide, particularly as to better lighting facilities.

FOREIGN ACTIVITIES

Cirrus Hermes Engine Announced

LONDON (ENGLAND)—A new four-cylinder engine of the in-line type has been produced by Cirrus Engines, Ltd. This product, called the Hermes, is rated at 105 to 115 hp In many respects it appears similar to its well-known predecessor of between 85 and 95 hp, which has been so famous for light plane installations

The main differences between the latest and the former Cirrus products is that the bore and stroke have been increased, giving higher power The compression ratio is 5.1-1, as compared with 5.4-1 in the Mark III The power weight ratio is less and the overall length has been decreased by placing the magnetos on each side of the cylinders.

Some of the specifications are as follows: Bore 4.45 in, Stroke, 5.12 in.; Weight, 295 lbs. with propeller boss; 105 hp, at 1,900 rpm.; 115 hp, at 2,100 r.p.m.; Gasoline consumption, 0.58 pints per hp hour at cruising speed; oil consumption 1 to 1½ pints per hour; overall length 38.4 in.; height 36 in., Width 19 in It has been designed to fit on regular Cirrus engine mounts.

Western Canada Plans Line

VANCOUVER (B C) — Western Canada Airways Ltd., one of the largest flying organizations in Canada, will establish a service from Prince George, B C., northward, using a Fokker Super-Universal, piloted by A. D. Cruickshank. May D. R. McLaren, British Columbia manager of the company, states the plane used will be equipped with floats for summer work and skis for winter. Mining prospecting will be undertaken in addition to other work and to facilitate this class of activities the plane will carry folding canoes

Vickers Designs Amphibian

MONTREAL (QUE.)—Canadian Vickers, Ltd., has designed a new twin-engined cabin monoplane of the amphibion type. The interesting design includes the following specifications: Span, 58 ft; chord, 9 ft 3 in; dihedral, 3 ft; incidence, 3 ft, width of hull, 6 ft 9 in; height of hull at main step, 6 ft 3 in; overall length, 39 ft 8 in.

House Planes by Trucks

ROME (ITALY)—Sixty Planes per hour may be carried in and out of the Littorio Airport near here by means of sets of double tracks along which run electric trucks

Foreign News Briefs

Air transportation concessions are being sought vigorously in Brazil as well as in other South American countries, by various companies Negotiations are reported progressing slowly, however

Wider use of aerial ambulances is being urged at the International Congress of Military Medicine, London

A plane will be used for survey work in connection with the extension of a Pacific Great Eastern Railway in British Columbia, Canada

A new aircraft manufacturing company to be known as the Clyde Engineering-National Airways, Ltd, has been organized in Australia. Production will be started on light planes and will be expanded later to larger machines

Four modern hangars are to be built at the Calgary airport in Alberta, Canada.

Following test on his Junkers L-3 with 340 hp engines, Capt. Allen Ahrenberg has announced that he expects to attempt his East-West trans-Atlantic flight early in June The route will be by way of Iceland, Greenland, the mouth of the St Lawrence River, and thence to New York.

Various locations are being studied near Santiago, Chile, for the construction of an airport provided by the gift of Daniel M Guggenheim

A special department in aviation securities has been opened by Peacock Lewis & Company, Ltd, Montreal

Airplane manufacturers in Germany, France, Italy, Czechoslovakia, and the United States, had conspicuous space at the recently held International Exposition of Sport and Touring Planes at Geneva, Switzerland.

International Airways of Hamilton, Ont, plans to establish a training school for pilots at Moncton, N. B.

To Use Ford In War on Insects

OTTAWA (CANADA) — A Ford transport is to be used this summer in extensive dusting operations conceived to combat the budworm in Canadian forests The Dominion Air Service, the Provincial Forest Branch of Ontario and the Dominion Entomological Branch are co-operating in this effort

Canadian Cities Building Airports

OTTAWA (CANADA)—Various airport projects are in progress in the Dominion The Toronto Harbor Commission is working on extensive plans for a combination land and seaplane terminal with repair shops, stores, depots, hangars and other equipment. A $500 000 project is being considered at Winnipeg where the James Richardson Company would build a large airport on the south side of the Red River.

The dedication date for the Hamilton, Ontario airport has been set tentatively as June 6. In British Columbia at least four communities in addition to Vancouver are working for airports They are Kelowna, Penticton, Cranbrook and Princeton

Arranging Winnipeg Display

WINNIPEG (MAN.)—The local flying club is making elaborate plans for its aviation show and field day here May 24-27 It will mark the club's first birthday anniversary. Planes from United States and Canadian commercial companies and other Canadian flying clubs are expected to participate On May 24, Club Day, competition, displays and races for flying club airplanes and members will be held. The following day will be given over to American pilots for similar events The exhibition of aircraft, engine models and accessories will be on view throughout the event.

Italian Ocean Flights Planned

ROME (ITALY) — Three Italian-built planes are expected to attempt trans-Atlantic flights this summer One, a Savoia-Marchetti S-64 is planning to fly from here to New York, and westward across the United States until its fuel is exhausted A specially constructed four-engined flying boat is about ready for an attempt, and a Caproni equipped with four engines of 250 hp each has been ordered by the Polish Government for a similar flight.

Put Hornets on Rohrbach

BERLIN (GERMANY) — Two Pratt & Whitney Hornets are reported being installed in the Rohrbach Rostra in place of two engines of European manufacture. On account of the change in power plant the proposed trans-Atlantic flight of the big plane has been postponed from May 15 to about June 1. The machine will take the southern route, making a few stops on the way, with New York City as its goal

THE BUYER'S LOG BOOK

Boundary Light

MANY accidents have been caused by airplanes striking boundary lights when alighting on an airport or flying field This hazard will be eliminated at Port Columbus, O., through the use of a new and improved type of boundary light that has been developed by E H Stork, engineer for the city in charge of the Columbus Municipal Airport, and Charles E Schuler chief electrical engineer for the International Derrick & Equipment Company of Columbus, O

The new type of boundary light

The chief advantage obtained in this new boundary light is that it can be struck by an airplane without damaging the plane, and with little damage to the light itself When struck the cone tips or collapses Wiring is so arranged that the balance of the lights will remain lighted without further attention even though one or more of the lights are out of commission

The shape of the base offers very little resistance to the wind stream created by the propellers of the plane, and the light will not turn over Furthermore, snow and ice will not stick to its surface The boundary light support is highly visible, both by night and day and can easily be seen from the air In conformance with the color scheme adopted by the Department of Commerce, the lights will be painted chrome yellow and striped with black

Being portable, these ground beacons can be moved about on the landing field to conform with the surface conditions of the field

Westinghouse Lamps

SEVERAL special types of Mazda lamps for aviation service have been developed by the Westinghouse Lamp Company These lamps may be divided into the following closses: (1) Lamps for airplane headlighting, (2) lamps for airway lighting, (3) lamps for airport floodlighting Special lamps were developed for landing light fixtures and the 35 ampere, 12 volt G-25 Mogul airplane headlight lamp is designed particularly for this purpose Another specially designed lamp is the 1,000 watt, 110 to 120 volt T 20 bulb, Mogul base for airway beacon service Installation of one of these lamps in a suitable beacon will produce a beam which is visible to a pilot more than 20 mi away

Recent development of airports throughout the country necessitated the designing of lamps suitable for floodlighting these large areas Four lamps were developed to meet the requirements of airport floodlighting service The first lamp, a 1 500 watt, 32 volt T-25 bulb two prong base, is used in 24 in projectors such as those made by several manufacturers These lamps are used to illuminate small fields or the runways of large fields To obtain a beam with the same vertical and horizontal spread as now obtained with the standard 24 in beacon, the 32 volt lamp similar to the one developed for airport flood-lighting service has been found satisfactory and provides a maximum candlepower of approximately 10 millions The specially developed 3 000 watt 32 volt GD-38 volt two prong base lamp is also used in the 24 in floodlight projector mentioned previously These lamps are used to light large airports and, when four or more are installed, will provide a suitable intensity for safe landings at night The third lamp of this group is a 5,000 watt 110 volt G-64 bulb two prong base Mazda lamp. This lamp was designed for use in a 500 mm dioptric Fresnel lens unit such as manufactured by the A G A Company and the B B T Corporation The fourth is a 10 000 watt 110 volt G-80 bulb two prong base Mazda lamp This lamp has been designed for use in a large dioptric Fresnel units as manufactured by the B B T Corporation or in a modified lighthouse lenses as used by the U S Army

Model 6, Pyrene Fire Extinguisher

The Model No 6 airplane fire extinguisher manufactured by the Pyrene Manufacturing Co, Newark, N J, is known as a gas cartridge type and combines an efficient fire fighting unit, together with a minimum of size and weight It differs from Model No 5, the standard air pressure type, in that a gas cartridge is used to store the pressure until released for operation It contains one quart of Pyrene Fire Extinguishing Liquid

This extinguisher, which is exceedingly simple in construction, combining lightness and rigidity, consists of a seamless drawn brass shell and cap to which is threaded, at the top, a bronze casting containing the valve mechanism and operating aluminum hand wheel and lever. This hand wheel and lever are so designed that they may be used singly or together and are held on the valve spindle by means of a spring lock for quick removal when desired The gas cartridge containing pressure to be used for expelling the liquid is held in a cradle at the mouth of the shell; the discharge valve is located inside of the shell at the other end By a quarter turn of the operating lever, the cartridge is punctured and at the same time this movement opens the discharge valve on the inside The pressure released by the puncturing of the cartridge expels the entire contents of one quart of Pyrene Fire Extinguishing Liquid

The extinguisher is furnished with an aluminum bracket and must be installed in a vertical position so as to discharge fully The bracket rotates around the axis of the extinguisher for convenience in attaching same on the airplane It may be installed near the pilot for immediate control or for remote control

SIDE SLIPS

By
Robert R. Osborn

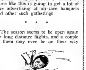
According to the news, the Department of Commerce is planning to start shortly a system whereby the aviator can pick up his radio telephone and inquire about the weather conditions in whatever direction he happens to be flying With the telephonic tradition that one always gets the wrong number added to the weather bureau tradition of always guessing wrong, the pilot is going to be in considerable of a quandary as to the value of this service If he got the right number the first time and was told that the weather was perfect ahead, his first instinct would probably be to abandon ship and take to his parachute

• • •

It is planned to make a Trans-Atlantic flight this summer in a "Rocco" seaplane Any ship with a "whoopee" name like this is going to get a lot of free advertising at air-race banquets and other such gatherings

• • •

The season seems to be open again for long distance flights, and a couple of them may even be on their way



before this appears in print Those announced so far vary from trans continental and trans-oceanic to a complete trip around the world, entirely by air A S of Mineola N Y, points out that no one seems to be considering the flight which would bring the greatest publicity of all,—non-stop from Hell, Norway, to Paradise, Illinois.

• • •

Mr S.W.J. of New York City and Bristol Pa, encloses a clipping from an advertisement in the Detroit *News* 'Sikorsky Aviation Corporation, producing the Sikorsky Amphibion, luxurious 800 hp air yacht Taking off on water or land and the only plane in the world that will climb and fly on only one engine

Looks as if someone is trying to stir up the old Wright Brothers-Langley controversy again

• • •

A radio direction indicator has been developed, by means of which a pilot can determine if he is on his course by simply watching an instrument on

the board in front of him Better file this one away for future use,—"I'm sorry, my dear, for being so late in getting home Some dumb mechanic at the field put an oil pressure gauge in the instrument board where my direction indicator is usually located and I was all of the way to Cherryvale Kansas, before I noticed the mistake"

• • •

Lt. M W., of Garden City, N. Y., quotes from an item in the New York *Herald-Tribune* "—and the completed plane was a creation in deep orange which spoke speed, dependability and comfort," and comments thereon as follows:

'Wouldn't a suitable slogan for this plane be 'It sells itself'—through the medium of its articulate color? It is not within my ken as to whether or not the color deep orange is multilingual Can this plane dispense with interpreters in the export field? Is there any record of this creation murmuring in its sleep, and if so, what has it said?

"But slacking up on the flapdoodle—I rise in defence of flam-

ing red. Do you recall the penchant for red of the famous speed merchant, Major De Bernardi, or of the late-lamented Baron von Richthofen, and the *dependability* of *speed* which *discomforted* their opponents? There's a clear case for you of red versus deep, shallow or any other variety of orange"

We refuse to be drawn into any controversy on colors for airplanes When our selection of colors in so simple a thing as a necktie can precipitate a fair-sized riot, as it has on several occasions, our discussion of airplane colors might have more people than ever threatening to cancel their subscriptions. Furthermore, we might start something we couldn't stop First thing you know, this new airplane company which will specialize in airplanes for women will be putting out models decorated in orchid, beige peach, nude sun-tan corn or lavender

• • •

There seems to be a bit of a social clash in aeronautical circles too, because of an oversight in not inviting a famous aviatrix to a dinner in Detroit at which a number of other lady aviators were present. Looks as if the Chilean ambassador will have to give another dinner so that we can get an official interpretation on this case

• • •

The Intrepid Aviator came into the office a few minutes ago, put a clipping of a cigarette advertisement on our

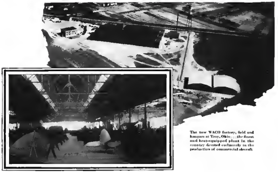
desk yawned expansively and sauntered out The advertisement was headed in large type, "—in the air it's *nerve*—in a cigarette it's *taste*"

• • •

Mr W. E D of Hanover, N H, writes in "Dear Sir —The Daniel Guggenheim Fund for the Promotion of Aeronautics is no doubt very familiar to you but I am sure you will be both surprised and pleased to see that Mr Guggenheim's money has been turned to an even more helpful end This appeared in the Boston *Herald* of April 25

NEW YORK, April 24—Col. Charles A Lindbergh believes that larger planes driven through the air by four motors is the next step in the fast changing development in passenger air transport.

In his office at the headquarters of the Daniel Guggenheim Fund for the Profer comfortable sleeping quarters."



The new WACO factory, field and hangars at Troy, Ohio . . . the finest and best-equipped plant in the country devoted exclusively to the production of commercial aircraft

Improved facilities for *greater values*

WACO owes its established reputation to sheer merit alone. It started from scratch. It worked its way, on its own capital, to a leading position in the industry. And today the reputation of WACO takes on a bigger meaning . . . gives even greater promise. For WACO occupies a new and larger plant . . . "one of the finest and best-equipped in the industry," according to aviation experts.

Improved facilities for every step in WACO production bring greater values to WACO owners . . . at consistently lower prices. Rigid adherence to exacting standards of precision and care . . . that is the secret of the "invisibles" through which WACO performance is judged supreme . . . particularly by those who *know* airplanes and who, by choice, fly WACOS. *Complete details and prices on request.*

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"ASK ANY PILOT"

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hits the bullseye of Popularity

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comfortably seated in a cabin low wing monoplane

—A snappy take-off—Up into the blue like a homesick angel—Landing gear completely drawn up and most parasitic resistance gone—SPEED, SPEED, SPEED and consequent fuel economy—150 m.p.h. with a 165 hp. motor
—The landing gear drops into locked position
—And the BULLET floats into the field so gently the dog slumbers on.

With Wright Whirlwind 165 hp. motor the BULLET is priced at $8,888—with Kinner 100 hp. motor $6,666. Both prices flyaway factory.

Communicate with Alexander Aircraft Co., Dept. 401, Colorado Springs, Colo.

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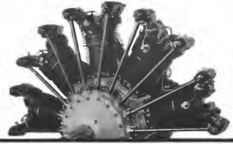

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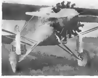

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The "Split-Second" Silvertown Airplane Tire with Stream-line Shield—an exclusive Goodrich feature

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Many World Records have *Proved* these tires

THE records of Aviation might well be termed "the records of Goodrich Silvertowns" For though many record-breaking flights have been made with many different makes of planes, propelled by several different makes of motors, in *almost every instance these record-breaking planes have been equipped with Goodrich "Split-Second" Silvertown Airplane Tires.*

Goodrich Silvertowns are *light* enough to permit three *extra* gallons of gas *Strong* enough to withstand *take-off* overloads . and the shock of forced landings even on barren, rock-strewn mountain sides of unknown lands. No mere claims need be made for *"Split-Second" Silvertowns . . . world records have proved them!*

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A MORE convincing test of strength and stamina could hardly be staged than the block test of Micarta propellers run by the Army Air Corps Engineering Division at Wright Field.

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Up and up goes the Ryan until a silvered speck disappears in the blue. A service ceiling of 18,000 feet, a top ceiling of 25,000 feet—marks for other cabin ships to shoot at.

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"Red" Harrigan at the factory, or any Ryan distributor will demonstrate these facts. We hope you're from Missouri, that's where Ryan lives.

On performance alone, Ryan built and sold in 1928 more Whirlwind cabin ships than any other maker.

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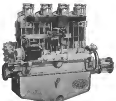

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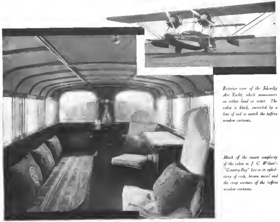

Exterior view of the Sikorsky Air Yacht which manoeuvers on either land or water The cabin is black, encircled by a line of red to match the taffeta window curtains.

Much of the smart simplicity of the cabin in J C Wilson's "Country Boy" lies in its upholstery of rich, brown moiré and the crisp airiness of the taffeta window curtains.

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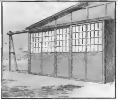

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When it was a CRIME to Look *Ahead*

"NONSENSE! Stuff and Twaddle!" said Isaac Newton to what 17th Century despots decreed as knowledge.

"Nonsense!" agreed Robert Boyle.

That was heresy . . . and heretics were treated roughly in those days. So the discoverer of the law of gravity and the father of the law of chemical science, aided and abetted by other truth-seeking rebels, formed a blind-pig scientific society. Its crude experiments, secretly conducted in secluded cellars, were destined to start the world's economic advancement.

Later, when it became lawful to question superstitions, this "Invisible College" was recognized as the Royal Society of London.

❖ ❖ ❖

How times have changed since the day of Newton and Boyle! Research . . . invention . . . exploration . . . industrial advancement—not tolerated, but *demanded* by an increasingly sophisticated population. What a premium today upon Vision!

American industry right now is pioneering in the spirit of Newton and Boyle—but with this difference: it is aided and exhorted by an industrial, engineering, trade and business press whose leadership is needed more than ever. For the stupendous accomplishments of industry have themselves become industry's greatest concern, imposing penalties upon engineers, industrialists and the heads of business . . . penalties for lack of clear vision . . . penalties for not looking ahead.

❖ ❖ ❖

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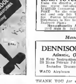

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At the largest and most modern equipped airport in the east, where flying conditions are ideal all year around school. Instructions under personal supervision of licensed transport pilots on New American Eagle Planes, with OX and Kinner motors. Students may obtain room and board on the field or within walking distance. Del-Mar-Va Flying School. Hebron Airport, Hebron, Maryland Wicomico County

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NR 111
MID-PLANE FLYING SCHOOL
Wold Chamberlain Field Minneapolis
one of the
Universal Aviation Schools

The fact that schools advertising in the WHERE TO FLY section of AVIATION have done so over a period of years is one of the best testimonials to the efficiency of this type of advertising.

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Tenth Ave. at 36th St.
New York

WHERE TO FLY

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Complete flying and ground courses under licensed transport pilots. New Travel Airs with OX5 Whirlwind and Comet motors. Send for free copy of "Skyward Ho!" one profusely illustrated catalog.
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Train with experienced instructors, using the most modern equipment. *Write for information.*
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AIRVIEW FLYING SERVICE, Inc.
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Waco and Fairchild Aerial Taxi Service to Any Point. Flying School Operated from the Finest Field on the Jersey Coast
Hangar Space at Reasonable Rates

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NEWARK AIR SCHOOL
LEARN TO FLY! Under the personal supervision of Capt. John O. Donaldson. Ten new ships. Expert instructors with at least 10 years active flying experience. Instruction thorough, rates moderate. Most conveniently located airport in metropolitan area. 20 minutes from N. Y. C. by car or tube to Newark and number 4 bus.
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Newark Metropolitan Airport Newark, N. J.
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LEARN TO FLY WITH
The EMBRY-RIDDLE Co.
AIRMAIL-CONTRACTORS
LUNKEN AIRPORT, CINCINNATI, O.
The country wide reputation of the Embry-Riddle flying school is based on outstanding methods by government licensed pilot instructors using only licensed planes and the most modern equipment. Flying and ground courses qualify students for federal licenses. Special course in gliding and soaring. *Illustrated Folder on Request*
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Complete ground and flight instruction. We train for any grade of license. The Little-Greiner Flying Service, Inc. Municipal Airport, Springfield Ohio. Distributors of Travel Air Planes, Central Ohio

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NR 178
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STULTZ FIELD
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80 Acres
Complete primary and advanced ground and flying courses.
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one of the
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PITCAIRN AVIATION of Pennsylvania, Inc.
10-, 20- and 50-Hour Flying Courses leading to Federal licenses conducted at Pitcairn Field, Willow Grove Pa., one of the largest in the East, in midst of ideal flying country. All-year-round school. Modern flying equipment. No liability bond required. Write for Illustrated Booklet.
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T. A. T. Flying School, Inc.
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All instructions under personal supervision
Licensed Transport Air Mail Pilots
Instructions given on both open and closed types of airplanes. Complete ground course in all subjects required to pass Department of Commerce Examinations. We also include radio in our ground course for transport pilots. A year 'round training school under the sunny skies of Texas. For information address T. A. T. FLYING SCHOOL, INC. 614 Fort Worth National Bank Building, Fort Worth—Texas

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Learn to fly at largest and finest Airport and School in the Northwest—New Challenger and Fairchild Air Planes used for instruction.
EXTRA SPECIAL
3 hours' cross country instruction on our giant 12-passenger Ford Tri-Motor Plane. Free to first 20 students enrolled. Under personal direction of Capt. L. G. Mulzer. Board and room can be arranged at Airport at very low rate.
Special attractive prices on all our courses—with easy terms.
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Professional Services

Do Not —Hesitate— to Ask

If you do not find the type of service you need listed in this directory, write to us at once. You will be put in prompt touch with reliable individuals and firms offering exactly the kind of service you need. Address, Searchlight Department, Tenth Ave at 36th St., New York.

SEARCHLIGHT SECTION

EMPLOYMENT and BUSINESS OPPORTUNITIES—USED and SURPLUS NEW EQUIPMENT

UNDISPLAYED—RATE PER WORD
Positions Wanted, Positions Vacant and all other classifications excepting equipment, 10 cents a word, minimum $2.50 an insertion. 15 cents a word if a box number address care of any of our offices is used.
Proposals, 40 cents a line an insertion.

INFORMATION
Box Numbers may be in care of our New York, Chicago or San Francisco offices.
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FOR SALE

BIG sale of aeroplanes. Positively the best buys in the United States—Two Whirlwind Wacos perfect condition loaded with extras; two Waco 10s with OXX-6 motors same as new; two Waco nines with OX-5 motors A-1 condition; two Travel Airs one with OXX-6 motor; two Eaglerocks combination wing excellent condition throughout. These ships are all licensed and must be seen to be appreciated. Priced from $1,200 to $6,750. We specialize in the sale of planes and motors carrying a complete line of Waco ships and several other makes both new and used. Free flying instruction with any new or used ships purchased from us. Act now. Be ready when the season opens. Becker-Forner Flying Service Inc., Jackson, Mich.

BEST Cash Offer takes one OXX-6 Standard perfect condition. Write for description. Many extras. Lewis W. Lirbey 176 Gates St. Waterloo Iowa.

FOUR Wright Whirlwind engines for sale. Two J-5's and two J-4's. These engines have been recently overhauled and test run. Guaranteed in perfect condition. Will exchange one of them for good licensed 3 place ship. Prefer Waco or Travelair. No junk wanted. What have you? Becker-Forner Flying Service Inc. Jackson, Michigan.

K-6 motor with Seagull prop hub, engine bed and radiator for sale, all in excellent condition except radiator. H. J. Laskin 236 Carey Road Boston 47 Mass.

EAGLEROCK, new OX-5 motor, less than 100 hours, practically new, recent top overhaul; terms. Farrel and Blake 1728 First Avenue New York City. Sacramento 7970.

FOR SALE. New OX-5 rebuilt OXX, never been started used OXX. Chas. H. Blosser, Belleville Kan.

FOR sale, Jenny 4 fly-away job, $650. Tremley recovered motor had 60 hours since overhauled. Axel Sorensen 738 Briar Place Apt 4b3 Chicago Ill.

FOR SALE: Two 110 hp. Mercedes aviation motors light in weight. Box 1182 Aviation Tenth Ave at 36th Street New York.

HEALTH Parasol complete less motor. A steel tubing job $200 for quick sale. Walter Batchunas. Ash Brook, New Jersey.

FOR SALE or exchange 100 hp. Mercedes touring car seven passenger. Aviation type motor. Box 1181 Aviation Tenth Ave., at 36th Street New York.

HEATH Super Standard for sale, entire ship overhauled last October, new linen, Hartzell propeller, underslung radiator, steel landing gear, motor completely cowled and turning 1400. Lost in hangar all winter, just the ship to get in those 200 hours, flyaway $1,300. Geo. Hersh, 1827 N. Keystone Ave., Chicago. Belmont 7317.

HISSO-A—Almost new revs, 1600 overhead radiator oil tank Stromberg carb-tachometer everything complete ready to install. Wonderful shape had but 3 hrs. Will sacrifice. Geo Belanger 394 Fielding St. Wayne Co. Ferndale Mich.

HISSO motors, model A—in good condition but not factory overhaul $325, with factory overhaul absolutely guaranteed $750; model E—represented to us to have government overhaul $850, with factory check and guaranteed as good as new $1,050. 220's—brand new $400. American Eagle Aircraft Corp. Fairfax Airport, American Eagle & Fairfax Roads, Kansas City Kansas.

USED FORD TRI-MOTOR

J-4 Motors Newly Overhauled

Exceptionally Fine Condition

FOR SALE—$22,500

On account of larger and higher-powered equipment being required on our scheduled airlines, this ship is offered at an attractive price for immediate sale.

Having had conservative handling by experienced pilots only and the best of care by licensed mechanics this ship is a rare bargain at the price quoted. It is equipped for passenger carrying and sightseeing trips, and will be sold subject to demonstration at the Ford Airport.

If so desired it will be equipped with J-5 engines at slight additional cost.

STOUT AIR SERVICES, Inc. P. O. Box 86, Dearborn, Mich.

FOR SALE

LATE production sport biplane new OX-5 motor turns 1,470 on ground with only 40 hours, dual control, compass, etc. Cruising speed 100 m.p.h. $1500 takes it. For further particulars write N. G. Salisbury, 336 Fifth Ave., Troy, New York.

LICENSED OX-5 Waco, motor revs 1,405 on the ground. Ship and motor in first-class condition. Ship kept in hangar. Price $2,300.

NEW and complete 80 hp. Le Rhone for sale with dual type carburetor, $90. Want Hisso, also 4 cylinder air cooled. Summit Beach Park, Akron, Ohio.

NEW OX 5 in original crate, complete with tools never run. $3.48. Aviation, 520 No. Michigan Ave., Chicago, Ill.

NEW Waco 10 used only 35 hours, complete in every detail, new Hamilton prop. Dual controls. Owner purchasing Whirlwind Waco. Air City Airways, Sharonville, Ohio.

NEW OX 5 cylinders are getting scarcer every day. We make your used cylinders like new. Valve guides installed $1.50 per guide, new valve seats installed $1.50 per seat, cylinders rebored. Our specialty overhauling OX-5 motors. Flyers Inc. Albany Airport, Albany, N. Y.

ONE Stinson biplane for sale J-6-CA motor, license NC-3000. Ship never damaged. Total hours low. Hundred hour rating. Motor runs 1600 on blocks. Ship and motor in perfect condition. Price $5,500. Montgomery School of Aeronautics, Montgomery, Ala.

OX-5 motor in first class condition, good chest, 65 hours. Turns 1,400 r.p.m. $300. Harold Christensen, Stoton Airport, 143 South Main St., Reading, Massachusetts.

ONE new upper right American Eagle wing without aileron $150. One used upper right $100. Used OXX6 American Eagle, $2,850. Excellent shape. Used OX5 American Eagle like new, $2,600. Also 2 OX 5 Waco and Standard biplane for sailing. Want to install larger planes for passenger flying. Frank E. Trantwein, Arcola Airport, Arcola, Route 1, 3 miles west of New York City. Phone Hackensack 6942.

ONE OX 5 Standard J-1 for sale, excellent condition throughout. 35 hours since complete overhaul. Price $1,500. Rymway Marcomb, Ill. Address: J. B. McGonigle, Macomb, Ill.

ONE Waco-10 in perfect condition, never overhauled, has about 100 hours. To see or take to the best cash offer. S. S. Terrill, Lincoln, Ill.

ONE Monocoupe in perfect condition, flown about 30 hours, $2,000, will demonstrate and deliver anywhere within a radius of 300 miles. Sears Motor Company, Lincoln, N. C.

New J-5
WRIGHT ENGINES
For Sale

One of the largest aircraft manufacturers has a few engines in excess of production requirements and is offering them for sale. Latest production and never used. Developing 225 H.P. at 1800 r.p.m. Here is an opportunity to secure a new Whirlwind at an exceedingly low price. A wire will bring complete information and price.

F S-52, Aviation
Tenth Ave. at 36th St., New York, N. Y.

OX-5 Standard in A-1 shape for sale. Completely recovered and motor thoroughly inspected last July by licensed mechanics, with reliable company. Always been in hangar since then. Motor has had 40 hours since complete overhaul by licensed mechanic. A good ship in which to run up that extra money. For sale. Iowa Airways Corporation, Fort Dodge, Iowa.

ONE Stearman with J-5 motor for sale. Has only had 55 hours. Fully instrumented. Dual instruments and controls. Earth inductor compass. Cost $10,000. Will sell for $8,500. Will include two flying suits never been used. Sheila Company, Champaign Air Port, Champaign, Ill.

OVERHAULED OX-5 motor complete with hub for sale. Motor is in A-1 condition. First $350 takes it. D. L. Kuhn, Altamont, Kansas.

PONTOONS. One pair Edo all-metal Standard C. Never in salt water. Never bumped. Always moored. Price $675.00 with new strut arrangement for any J-6 ship. M. J. Hunter, 177 So. Front St., Memphis, Tenn.

PITCAIRN OROWING, good condition. One for student training. Miller Corp., New Brunswick Airport, New Brunswick, N. J. Tele. phone 836.

QUICK sale, cheap, second hand OX-5 Eaglerock, good condition, complete overhaul, combination wing, D. C-3488, new covering, new wings, new paint, new split type undercarriage. $2,000. W. P. Scott, Jr., Little Rock, Arkansas.

STINSON Detroiter Monoplane: Six place cover cushion, 80 hours, since factory motor overhaul. Has never been completely rebuilt, whirlwind recovering wings, fuselage and surfaces, painting blue and gold, upholstering cabin, leather seats. Spare standard steel propeller. Priced for quick sale at $7,500. Palwaukee Airport, Inc., Illinois.

STINSON Junior Warner Scarab purchased new last October, 100 hours, 20 hours since complete factory overhaul. Equipment includes Pioneer compass, Waltham clock, Pioneer bank turn and climb indicator, two propellers. Ship in first-class condition throughout, licensed by Department of Commerce, owner selling at sacrifice to buy larger ship. $5,000 cash takes it. J. L. Ross, Jr., 307 No. Michigan Ave., Chicago, Ill.

FLYING BOAT
6 PLACE DUAL

Control, 165 hp. Wright E2—licensed. New prop. Lower wings and tail surfaces recovered. Located at Miami, Fla.

RAY APPLEGATE
36 W. 40th St. New York

THREE-PLACE STEARMAN

Completely overhauled, new paint, pigmented dope. Spick on wings, new Pioneer instrument board with new type compass, 16 cylinder Ross and Hamilton prop., Spick dual control. Also another mechanic has been vacation at old bushings. Will sell at price, $7,500. G. H. Patterson, care of George Wise Hanger, Curtiss Field, Garden City, L. I., N. Y.

HENDERSON MOTORS

Henderson 4-cylinder air-cooled aircraft motors, conversion parts, blueprints, propellers all sizes

Send stamp for our price list

American Beauty Aircraft Sales
1765 Sunnyside Ave., Chicago

STINSON Detroiter for sale. 6-place ship, 165 hours, five thousand dollars—motors overhauled. 50 hours ago. Everything in perfect condition, never been in crash of any kind. Brundage & Fryer Co., 2641 N. Kedzie Ave., Chicago, Ill.

STINSON 4 passenger cabin biplane, new finish, new upholstery. Whirlwind, overhauled by Wright factory. Never cracked. Dual stick control. $4,500. OX Standard, $485. Well licensed passenger seaplane or flying boat. Lloyd Henry Tooey, Lock Oak, Texas.

SWALLOW three place dual controls, two months old, excellent OX 5 motor. Dept. of Commerce NC license. Less than 200 hours total time. This new one mechanically perfect. $1,850. Ideal for cross-country or piling up time for transport license at low cost. First $1,850 takes it. Ready to fly away. F. A. Emery, 1350 Lafayette, Detroit, Michigan. Lenox 2574.

TRAVEL Air OX-5 motor just completely gone over and Miller overhead and pistons installed. Turns 1,525 on the ground. Ship just recovered with Flyers A. Has 60x8 tires, brakes, navigation lights, compass, altimeter, extra wonderfully flying ship. New process Boeing color dope. Bright red. Cost $3850. Will sell for $2,850. Wm. J. Osmelet, 2727 Locust St., St. Louis, Mo.

TWO (2) OX-5 Travel Air biplanes for sale. Like new, dual controls, good compass. Both licensed. Priced to sell. Can be seen at Pine Bluff, Arkansas. Pine Bluff Airways, Inc.

TWO Dixie 22 magnetos, overly new, $15 each. Wanted, center upped propeller for Standard J-1. 225 Hisso motor must be A-1 condition. Wings Aero Electric, Idaho Falls, Idaho.

FOR sale, Eagle Rock dual control OX motor. This ship has been privately owned and stays in the hangar at all times, never used for passenger or training ship, never had a crash up and is in wonderful shape. Box 457, Memphis, Tenn.

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IS
Opportunity
Advertising

—to help you get what you want.

—to help you sell what you no longer need.

Take Advantage Of It
For Every Business Want
"Think SEARCHLIGHT First"

6-38

FOR SALE

REBUILT OX5 Motors $455, used $335 and up. OX parts. What do you need? Jestes Aircraft Supply Co., St. Louis, Mo.

ALLISON sport monoplane for sale with Ford converted motor. New covering, new prop, new tires, attractive ship, neat paint job. $400. Hargraves Motor Co., Main St., Beaumont, Texas.

FOR sale—24 nine-cylinder and 6 seven-cylinder Gnome rotary aircraft motors. New, never been operated. Prices $100 each. L. M. Trotter, 507 Neches St., Jacksonville, Texas.

STANDARD J-1 OX-5 motor just overhauled, structure and fabric guaranteed same as new. Nose radiator, D.H. undercarriage, dual control. Hamilton Airport, Hamilton, Ohio.

FOR sale: Five new OXX-6 engines, $805 each, seven rebuilt model A Hissos, $550 each, also A-? Hissos first overhaul $350 each. All the above engines block tested. One new heavy gear type Liberty 12, $600. New OX 5 and Hisso parts. Write or wire Heckman Machine Works, 4020 West Lake Street, Chicago, Ill.

EQUIPMENT WANTED

DOUBLE park Irvin air chute wanted. State condition. Red Wing Flying Service, Inc., Ware, Mass.

The Searchlight Advertising in This Paper

is read by men whose success depends upon thorough knowledge of means to an end—whether it be the securing of a good second-hand piece of apparatus at a moderate price, or an expert employee.

The Best Proof

of this is the variety of this journal's Searchlight ads. Without a constant and appreciable demand for such equipment or services, by its readers, the market-place which these advertisements represent could not exist for any length of time.

Are you using the Searchlight Section?

WANTED

WANTED—25 or more OX-5 motors, new or used. Write E. Thomas, 147 Haverkamp Street, Brooklyn, N. Y.

WANTED: Used OX-5 motors or parts. Also OX-5 crankcases and OXX 6 crankcases. Box 782, Aviation, Tenth Ave. at 36th St., New York.

SECOND-HAND pontoons wanted for OX 5 Travel Air. State condition and lowest price. Ernest H. Crosby, Parks Air College, E. St. Louis, Ill.

USED biplane wanted with steel fuselage and motor for rebuilding and incorporating new invention in exchange for partnership in new venture. W-66, Aviation, Tenth Ave. at 36th St., New York.

WANTED—S. E. Scout or Sopwith in flying condition. Price S. E. A. C. Smith, Dyer Dock, Muskegon, Mich.

POSITIONS VACANT

AIRPLANE draftsmen, designers and detailers of more than one year's experience. Successful young men desired to take part in the expansion program of a long established company with unusual future possibilities. State full particulars and qualifications in first letter. The Glenn L. Martin Company, Baltimore, Md.

DRAFTSMAN wanted. Aeronautical, mechanical or structural with experience in layout and detail work. P-64, Aviation, Tenth Ave. at 36th St., New York.

LICENSED airplane and engine mechanics wanted for large established aviation company on Long Island. Write experience in detail. P-70, Aviation, Tenth Ave. at 36th Street, New York.

TRANSPORT pilots wanted for commercial operations, careful and conservative, for instruction, passenger and cross-country flying. Permanent positions for dependable and reliable pilots. Robbins Flying Service, Akron, Ohio.

TWO licensed airplane and motor mechanics wanted. Amateurs need not apply. Robbins Flying Service, Akron, Ohio.

POSITIONS WANTED

AIRPLANE radio mechanic and operator desires position as radio mechanic or instructor in radio at reliable aviation school. Experience, two years an instructor in radio mechanics and two years university credit. Further information upon application. PW-67, Aviation, 520 No. Michigan Ave., Chicago, Ill.

CHIEF engineer of long aviation experience wishes to make change. Has executive as well as technical ability. Is willing to serve in lesser capacity in proper organization. PW-50, Aviation, 7 South Dearborn St., Chicago, Ill.

LIMITED Commercial Pilot, 105 hours flying, wishes position with concern or individual. A-1 mechanic. Will go anywhere. PW-55, Aviation, Tenth Ave. at 36th St., New York.

LIMITED commercial pilot experienced on cabin wants job licensed or unlicensed. R. W. McGhee, Emmerson Hotel, Apt. 200, Kansas City, Mo.

POSITION VACANT
Experienced Aeronautical Engineer

for design and layout work of large established commercial aircraft factory. Salary open. Address Aviation Box F-48, Aviation, Tenth Ave. at 36th St., New York City

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WANTED
Used Aircraft and Motors
all types, give full particulars and lowest price

NORTHERN AERO CORP
4 Hanover Square, New York City
Phone Beekman 0676

POSITIONS WANTED

LICENSED airplane and engine mechanic, now employed, wants steady position with future. Five years experience in aircraft construction and inspection. Can furnish references. PW-63, Aviation, 520 No. Michigan Ave., Chicago, Ill.

LICENSED airplane and engine mechanic with 6 years experience desires responsible position preferably in the East. Best references. PW-71, Aviation, 520 No. Michigan Ave., Chicago, Ill.

PILOT with limited commercial license desires position, am experienced in all phases of aeronautics, best references from noted pilots. E. L. Richards, RM-304, BDVW Hotel, East St. Louis, Ill.

PILOT. Boy nearly 18, over 150 hours solo and factory experience wants connection with reliable company anywhere in world. Has travelled lot and is well known. Excellent references. PW-55, Aviation, Tenth Ave. at 36th St., New York.

PILOT with eleven hundred hours flying experience all types, now flying, desires position. B. C. Taylor, 170 Motor Ave., Salt Lake City, Utah.

TRANSPORT pilot, and mechanic. Desires job with Transport company. P. O. Box 1292, San Diego, Cal.

TRANSPORT pilot—2,000 hours barnstorming experience. Flying since 1918. Army Reserve Corps, sales experience. J. L. Parkhill, 115 N. Institute St., Peoria, Ill.

YOUNG man, 24, wants position with some flying field or reliable party as wing walker, parachute jumping or airplane radio work. Paul Marlie, Osnabrock, N. D.

MISCELLANEOUS

ATTENTION Aviators. Valve guides installed on OX cylinders $1.50 per guide, removable valve seats installed $1.50, descriptive literature upon request, all work guaranteed. Illinois Flying Co., New location 4 West 4th St., Sterling, Ill.

ATTENTION Carolina Airmen—The best equipped shop in the Carolinas for rebuilding, crack ups our specialty, write or wire us your needs. Cable Brothers, Monroe, N. C.

DEALERS anywhere. I can help you if you are having difficulty selling quantity of aeroplanes your factory requires sold. Walter L. Henkle, Hotel Eaver, Hot Springs, Arkansas.

WHY take chances with boring, honing or other inferior methods of cylinder reconditioning. We use a Heald Grinder the same as large aircraft engine manufacturers use. OX 5 cylinders reground including pistons, rings, wrist pins and rods aligned complete $82.50. Povlik Machine Works, Kenilworth, Illinois.

MACHINE shop service on OX-5's. Cylinders reground, new pistons, pins and rings. Graphite guides and inserted seats installed. Oversize pins installed in valve actions. Main and connecting rod bearings line reamed. All work guaranteed. New OX 5 parts. Write for complete circular. Heckman Machine Works, 4020 West Lake St., Chicago, Ill.

BUSINESS OPPORTUNITY

Wanted to Purchase

For cash, used OX5 Motors, any condition. Write or wire R. Jestes, 1744 N. Euclid, St. Louis, Mo.

POSITION WANTED
PILOT

OLD-TIMER—COMPETENT TRANSPORT unlicensed, needing 30 hours recent flying, will do anything anywhere free for time in air and will pay all costs. OPPORTUNITY for private owner to get instruction free. PW-68, Aviation, 520 N. Michigan Blvd., Chicago, Illinois

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AGENCY WANTED

North Italian Consulting Engineer, aviation experience, wide connections in Italy, would represent American aeronautical concern.

AW-62, Aviation
Tenth Ave. at 36th St., New York City

Index to Advertisers

MANUFACTURERS' SPECIFICATIONS ON AMERICAN COMMER

THE TABLE BELOW IS BELIEVED TO BE ACCURATE BUT *AVIAT*

This table will appear monthly a

MANUFACTURER	Designation	Price of Plane at Factory	Type	No of Seats	Make of Engine	Total Rated HP	Make of Propeller	Span	Wing Area (Sq Ft)	Length Overall	Height Overall	Weight Empty (Lb) With Water If Water Cooled Engine is Used	Pay Load (Lb)	Disposable Load (Lb)	Normal Gross Weight Loaded (Lb)	Wing Loading (Lb per Sq Ft)	[illegible]
Advance Aircraft Co.	Waco 90.	$2,035	OBL	3	OX 1	90	Hs	30' 7"	286	23' 6"	9'	1 225	800	800	2 011	7 08	22
Advance Aircraft Co	Waco 220.	7 341	OBL	3	J 1	[illegible]	H, Hs, SS	30' 7	286	22' 6"	9' 3"	1 350	690	1 050	1 600	9 09	11
Aero-Craft Mfg. Co	Aero-Coupe.	5 000	SBL	3	W	110	F	31	250	24	8' 6"	1 100	150	1,000	1,000	8 40	19
Alexander Aircraft Corp	Eaglerock A 1		OBL	3	J 1	[illegible]		36' 8"	330	24' 11"	9' 11"				2,491	7 54	11
Alexander Aircraft Corp	Eaglerock A-2	2,250*	OBL	1	OX 5	90		36' 8'	330	24' 11"	9' 11"				2,447	[illegible]	22
Alexander Aircraft Corp	Eaglerock A-4		OBL	3	E	180		36' 8'	330	24' 11"	9' 11"				2,610	7 73	14
Alliance Aircraft Corp	Argo	4 500	OBL	1	Wr	125	SS	27' 8'	203	19' 6"	9'	1 000	265	650	1,650	8 13	13
American Eagle Aircraft Co		2,983	OBL	1	OX 5	90	H Hs	30'	300	24' 6"	8' 4"	1 227	840	830	2,051	6 85	22
Arrow Aircraft Corp	Arrow Sport	[illegible]	OBL	2	LB	60		25' 6"	170	19' 2"	6' 11"	524		450	974	5 35	16
Bach Aircraft Co	Air Yacht	31,500	CML	10-12	[illegible]	650	[illegible]	[illegible]	412	36' 1	9' 6"	3,300		3,200	6 500	15 77	10
Bellanca Aircraft Corp	CH	14,500	CML	6	J 1	[illegible]	[illegible]	46' 4"	271	24' 9"	8' 6"	1 650	2 229	3,284	5,134	18 90	21
Berliner Aircraft Co	CM 4	1 290	OML	1	OX 1	90	H, Hs	[illegible]	219	25' 10"	8'	1 400		[illegible]	2,300	10 50	25
Berliner Aircraft Co.	CM 1	8,950	OML	1	J 5	[illegible]	SS	[illegible]	219	25' 10"	8'	1 673		1,025	2,700	12 32	11
Bird Wing Commer. Airplane Co	No 6	2 791	OBL	1	OX 5	90	Hs	31' 4"	305	23' 6"	4' 7"	1 236	550	1,019	2 255	7 44	25
Boeing Airplane Co	40-B	24,500	SBL	1	P Wh	[illegible]	H M	[illegible] 2"	545	33' 4"	11' 8'	3 543	1 438	3,536	6,079	11 11	15
Boeing Airplane Co.	40-C	22,500	SBL	3	P Ww	[illegible]	H M	[illegible] 2"	543	33' 4"	11' 8'	3 522	1 443	2 551	6,075	11 14	12
Boeing Airplane Co	B-1E	18 500	CBF	6	P Ww	[illegible]	HW	39' 8'	545	32' 6"	12'	[illegible]	750	1 460	4,550	8 36	11
Boeing Airplane Co	B-1D	13 000	CBF	4	J 1	[illegible]		39' 8'	466	30' 9"	11'	1 442	720	[illegible]	3,442	7 38	17
Bourdon Aircraft Corp	Kitty-Hawk.	1 300	OBL	3	Sh 14	101	W	28'	233	22' 6"	8' 8¼"	1,142	360	[illegible]	1,950	8 36	16
Brown Aircraft Co			CML	6	J 5	[illegible]	SS	41'	260	27	10' 6"	[illegible]		[illegible]	2 350	9 90	12
Buhl Aircraft Co	Airsedan-C3A	12,500	CBL	1	J 5	[illegible]	SS	42	334	[illegible]	10'	2 072	1 000	[illegible]	3 700	11 07	18
Buhl Aircraft Co	Airsedan CA-3C	17 000	CQL	3-4	J 5	200	M	36'	240	25	8' 6"	1 900	651	1 000	1 200	11 33	16
Buhl Aircraft Co	Junior Airsedan	5 000	CQL	1	W	110	M	36'	240	25	8' 6"	1 500	570	1 000	2 500	10 40	22
Cessna Aircraft Co	3-120	5 750	CML	3	A	120	H, Hs	40' 6"	224	23' 8"	7' 4"	1 350	480	750	2 090	8 72	16
Cessna Aircraft Co.	4-125	4 073*	CML	4	Sh 12	125	H, Hs	40' 6"	224	23' 8"	7' 4"	1 260	760	1,030	2,260	10 13	18
Cessna Aircraft Co.	4-200	9 800	CML	4	J 1	200	H, Hs	40' 6"	224	23' 8'	7' 4"	1 350	800	1 070	2,420	10 90	11
Command Aire Inc.	Comm d-Aire	2,450*	OBL	3	OX 1	90	H	[illegible] 6"	[illegible]	24' 6"	8'	1 271	373	800	2,075	6 91	23
Curtiss Robertson A'p'lne Mfg. Co.	Robin.	4 000	CML	1	OX 5	90	Hs	41'	241	25' 9"	7' 10"	[illegible]	328	[illegible]	2,217	9 84	24
Driggs Aircraft Corp.	Dart II	1 000	OBL	2	A 3	35	Hs	[illegible]	140	19' 6"	6'	450		[illegible]	820	5 81	25
G. Elias & Bro Inc	Aircoupe	3 350	CML	2	A	90	Elias	28' 1½"	193	21'	7' 2"	870	510	[illegible]	1 334	6 94	16
Fairchild Airplane Mfg. Corp	Fairchild 21	4 250	OML	2	G	90	HW	28'	130	22'	4' 10½"	755		[illegible]	1,350	8 99	13
Fairchild Airplane Mfg. Corp	Fairchild 41	8 950	CML	4	J 5	[illegible]	Hs	39'	234	24' 7"	6'	2,000		1,600	3 600	11 38	18
Fairchild Airplane Mfg. Corp	Fairchild 71	18 300	CML	7	P Ww	[illegible]	SS	50'	[illegible]	32' 10¼"	9' 4"	3,000		2,500	5 500	16 56	13
Federal Aircraft Corp	CM-1	12,500	CML	5	J 4 B	[illegible]	[illegible]	32' 4"	262	28' 3"	9'	2 080	650	1 395	3 473	13 26	11
Fleet Aircraft, Inc	Fleet Model 1		OBL	2	W	110		28'	195	20' 9"	8' 9"	978		[illegible]	1,532	7 84	11
Fokker Aircraft Corp.	Universal	11 000	CML	5-1	J 8	300	H, Hs	47' 9"	[illegible]	33'	7' 10"	2 300	1 650	[illegible]	4,000	11 72	13
Fokker Aircraft Corp.	Super-Univ	21 800	CML	6-8	P Ww	400	SS	50' 7"	370	36' 7"	8' 11'	3 000	1 134	[illegible]	5 150	11 91	12
Fokker Aircraft Corp.	Fokker F 10	67 500	CML	14	3 P Ww	1 200	SS	79' 3"	850	50'	12' 6"	[illegible]	2,492	[illegible]	[illegible]	15 41	10
New Standard Aircraft Corp	D-24	6 000	OBL	5	E	180	H	45'	350	26' 6"	10' 2"	2,066	700	1 334	3,000	9 11	16
General Airplanes Corp	Aristocrat	7 300	CML	1	W	110	SS	38' 4'	194 1	25' 2"	7' 2"	1 244	365	[illegible]	[illegible]	10 96	19
Hamilton Metalplane Co	H-45		CML	8	P Ww	[illegible]	H	54' 1'	387	34' 8'	9' 4"	3 000	1,133	[illegible]	5 150	14 33	14
Hamilton Metalplane Co	H-47		CML	8	P Wh	[illegible]	H	54' 5'	387	34' 6"	9' 4"	3 450	1,041	[illegible]	5 350	14 81	11
Heath Airplane Co	Parasol	495	OML		H	23	[illegible]	25'	94	16' 9"	5' 11"	290		229	511	3 41	22
International Aircraft Corp.	F 11	2,950	OBL	3	OX 5	90	H	33'	325	25'	9' 6"	1 090	320	[illegible]	2 190	6 49	23
International Aircraft Corp.	F 18	12,250	CBL	6	J 5	300	SS	[illegible]	360	27' 6"	10' 6'	2,000	950	1,550	3,750	10 41	18
Ireland Aircraft, Inc.	Neptune.	14 000	CMA	5	J 5	[illegible]	CR	40'	350	31' 6"	11' 6'	2,250	250	1,150	3,000	10 30	18
Irwin Aircraft Co	M-T-2	1,161	OBL	1	I79	25	[illegible]	20'	105	13' 6"	5' 9"	275	100	300	111	3 47	25
Keystone Aircraft Corp.	Patrician	90 000	CML	[illegible]	1 Cy	1 175	SS	90'	1 000	63'	13'	8 505	3 000	2,461	11 000	11 00	9
Keystone Aircraft Corp.	Pathfinder		CBL	12	1 J 5	[illegible]		66' 6"	1,150	40'		6,536	1 600	4,491	10 841	9 41	10
Kreider-Reisner Aircraft Inc	Challenger C2	2,240*	OBL	3	OX 5	90	Hs H	30' 1"	296	23' 3"	9' 4"	1,200	442	811	2 011	7 56	22
E. M. Laird Airplane Co.	Commercial		OBL	3	J 5	200	SS	34'	300	23' 6"	9' 3"	1,350	800				
Lincoln Aircraft Co	Lincoln Page		OBL	3	OX 1	90		32'	300			1,200	450	1 000	2,200	7 33	24
Lockheed Aircraft Co	Vega.		CML	5-7	J 1	[illegible]	SS Wr	41'	271	27' 5"	8' 6"	1 550	1 000	1 150	3 200	11 84	16
Lockheed Aircraft Co	Air Exp		CML	5-7	P Ww	[illegible]	SS	41'	275	27' 3"	8' 6"	1 650	1 000	1,841	3,841	11 25	9
Loening Aeronautical Engr. Corp.	Cabin Amphibian	27 300	CBA	6	Cy	325	SS	46' 8"	[illegible]	34' [illegible]	13' 2"	3 940	1 400	[illegible]	5 600	11 41	11
Mahoney Ryan Aircraft Corp	Ryan B-1	12,200	CML	5	J 5	200	[illegible] W	42'	290	27' 1'	9' 10"	1 570	800	1 450	3 300	11 37	16
Metal Aircraft Co	C-2-W	21,000	CML	8	P Ww	410	SS	50'	365	32' 6"	9' 6'	2 600	1,413	2,840	1 600	13 34	11
Mono Aircraft Inc	Monocoupe	2,671	CML	2	V	55	Hs	30'	156	19' 6"	6' 3'	700		[illegible]	1,131	7 43	31
Mohawk Aircraft Corp.	Pinto	2 771	OML	2	V	55		30' 6'	124	22'	6' 3"	850	200	500	1,350	10 88	24
Szekely Aircraft & Engine Co	Flying Dutchman	2,000	OML	1	Sz	40	F	26'	198	16'	6' 6"	551 1	231 5		800	3 70	[illegible]
Paramount Aircraft Corp.	Cabinaire	7 200	CBL	4	W	110	SS	34' 0"	322	23' 9"	9'	1,300	620	900	2 200	6 83	[illegible]
Pheasant Aircraft Co Inc	H 10	2,375	OBL	3	OX 5	90	Hs	32' 6"	283	23' 6'	9'	1,297	800	785	2,082	7 35	23
Pitcairn Aviation, Inc.	Mailwing	10,000	OBL	1-1	J 5	[illegible]	SS	33'	253	22' 10'	8' 10"	1,612	800	770	2,111	9 96	11
Pitcairn Aviation, Inc.	Super Mailwing.		OBL	1-2	J 5	200		31'	263	[illegible]	9' 3"	1,840		1 160	3 000	11 06	11
Pitcairn Aviation, Inc.	PA-4		OBL	3	OX 1	90	Hs	30'	[illegible]	21' 10"	8' 7"	[illegible]		[illegible]	1,950	8 62	31
Prudden Aircraft Corp	S-E-1	22,500	CBL	6	P Ww	[illegible]	SS	57'	427	38'	9' 5"	3 000	1,200	2 065	5 061	11 86	13
Richmond Airways, Inc	Sea Hawk		OMF	5	C 6	160		[illegible]	117	30'		1 700		[illegible]	2 700	6 51	15
Sikorsky Mfg. Co.	S-37		CBL	18	2 P Wh	1,000		100'	1,049	45' 6"	16' 3"	8,000	4 000	7,000	15 000	14 29	11
Sikorsky Mfg. Co	S-38 Amphibian		COA	10	2 P Ww	800	SS H	71' 8'	720	40' 3"	13' 10"	6,000	2 210	4 000	10 000	13 88	11
Simplex Aircraft Corp	Red Arrow	3 950	CBL	2	K 5	100	Sty	33' 4"	148	20' 3"	[illegible]	[illegible]		800	1 060	10 81	16
Starling Aircraft Co			OBL	1	OX 1	90		32'		23' 4"	9'	1 237		[illegible]	1 831		20
Stearman Aircraft Co	C-2-K	6 380	OBL	1	Sh 12	125	H, Hs	[illegible]	296	24'	9'	1 281	350	[illegible]	2,150	7 26	17
Stearman Aircraft Co	C-3-B	8,130	OBL	3	J 5	200	H CR	[illegible]	296	23'	9'	1 438	400	[illegible]	2,000	8 10	12
Stinson Aircraft Corp.	SM 1D	17 500	CML	6	J 5	200	H	45' 10'	292	32'	8' 6"	2,400	1 540	[illegible]	4 000	13 41	22
Stinson Aircraft Corp	Junior SM 2	6,950	CBL	4	W	110	Wd	41' 6"	236	26' 3"	7' 3"	1 510	593	990	2,500	10 59	22
Spartan Aircraft Co	C-1	1,250	OBL	1	Wal	135		32'	293	22' 11"	8' 9"	1 900	448	650	1 150	[illegible]	13
Stout Metal Airplane Co.	4 AT		CML	11	3 J 5	600	SS	74'	785	49' 10"	12' 8"	6 200	2,200	1 900	10 000	13 73	16
Swallow Airplane Mfg. Co	Commercial		OBL	3	OX 5	90		32'	300	24'	8' 6'	1 431	360	750	2,200	7 33	24
Taylor Bros. Aircraft Co	Chummy	3,800	SML	2	K 3	100		34'	115	22'	7' 6"	950	100	150	1 500	8 17	11
Texas Aero Corp	Temple		OML		J 5	200		39' 4"	225	25' 10"	8' 3"		567		1 250	10 00	11
Thaden Metal Aircraft Co	T-4		CML	7	P Ww	400		53'		35'	11	2 900		2,200	1,100		12
Travel Air Mfg. Co	2000	2,930	OBL	1	OX 5	90	H Hs	34' 8'	296	24' 2"	8' 9'	1,350	550	350	2,100	7 09	23
Travel Air Mfg. Co	4000	9,100	OBL	3	J 5	200	H	34' 8'	296	23' 6'	8' 9'	1,900	600	1 000	2,800	8 78	13
Travel Air Mfg. Co	6000	13 000	CML	3	J 5	200	SS, M	44' 7"	282	30' 10¼'	18' 8¼"	2,473	944	1 625	4 100	14 51	21
Wallace Aircraft Co	Touroplane B	4,881	CBL	1	K	100	Hs		212	23' 10½	8'	1 320	380	380	2,100	9 90	21
Whites Aircraft	Hum. Bird	2,150	OBL	1	OX 1	90	Hs	33' 1"	318	23' 6"	8' 3"	1 050	450	650	[illegible]	1 84	21
Western Airplane Corp	King Bird	2,500	OBL	3	OX 1	90	Hs	35	320	25' 4"	9'	1 000	800	800	2,000	6 25	22

TYPE
A —Amphibian
B —Biplane
C —Closed
F —Flying boat
L —Landplane
M —Monoplane
O —Open
Q —Sesquiplane
S —Semi-closed
W —Seaplane

ENGINE One engine unless stated in italics
A —Anzani
C 6 —Curtiss
Ca —Comet
Cy —Wright Cyclone
E —Wright Hispano-E
G —Genet
H —Henderson
I79 —Irwin
J 5 —Wright Whirlwind
K —Kinner
L —Liberty
LB —Le Blond
LR —LeRhone
OX 5 —Curtiss
P Wh —Pratt & Whitney Hornet
P Ww —Pratt & Whitney Wasp
SR —Super Rhone
SH —Siemens Halske
Sz —Szekely
V —Velie
Wal —Walter
W —Warner
Wr —Hess Warrior
* —Price without engine

PROPELLER
CR —Curtiss Reed
F —Flottorp
H —Hamilton
Hs —Hartzell
M —Metal
Sty —Story
SS —Standard Steel
W —Wood
Wh —Westinghouse

FUSELAGE
B —Bolted
Cor —Corrugat
D —Duraluo
F —Fabric c
Mon —Monocoq
O —Open sea

BRAKES
B —Bendix
Ex —Extra
H —Hydraul

CIAL AIRPLANES AND SEAPLANES AS COMPILED BY *AVIATION*

N DOES NOT ASSUME RESPONSIBILITY FOR THE FIGURES GIVEN

orrections and suggestions are invited

High Speed in M P H	Cruising Speed in M P H	Landing Speed in M P H	Climb at Sea Level in F P M	Climb to 10,000 ft in Minutes	Service Ceiling in Feet	Fuel Capacity in Gallons	Normal Range in Miles	Normal Fuel Consumption at Cruising Speed Gal. Per Hr	Fuselage Construction	Wing Construction	Are Wings Wired for Lighting?	Type of Control	Brakes	Type of Shock Absorber	Dept. of Commerce Type Certificate Number	Performance Figure Guaranteed?	
Performance with Full Load at Sea Level as Supplied by Manufacturers																	
96	85	35			15,000	48	450	8	Wl-ST	Wd F	Yes	SPD	Ex	O-S	15		Advance—Waco 90
155	118	40	1,200		10,000	65		12	Wl-ST	Wd F	Yes	SPD	Ex	O-S	41		Advance—Waco 220
110	100	58	900		12,000	44	460	6 6	Wl-ST	Wd F	Yes	SD	B	Arl	Apl	Yes	Aero-Craft—Coupe
150		50	1,080		17,900				Wl-ST	Wd F		SCD		RC	56		Alexander—Eaglerock A-1
100	87	34	514		11,500	46	435	10 3	Wl-ST	Wd F		SCD		RC	7	Yes	Alexander—Eaglerock A-2
121		40	840		14,700				Wl-ST	Wd F		SCD		RC	58		Alexander—Eaglerock A-3
125	100	40	1,050		15,500	55	425	8	Wl-ST	Wd F	Yes	D	Yes	RC	Apl		
101	85	30	575	45	12,000	42	425	7 5	Wl-ST	Wd-F	Yes	SPD	Ex	RAR	17	Yes	American Eagle
105		36	900		15,200				Wl-ST	Wd-F		S		RC			Arrow—Sport
150	110	45	1,100	12	16,000	170	800	32	Wd-F	Wd-F	Yes	DeCD	S-B	Hy-C		Yes	Bach—Air Yacht
128	110	46	850		13,000	92	800	10	Wl-ST	Wd-F	Yes	SCD	Yes	RC	47		Bellanca—CH
105	65	41	450	40	15,000	37	800	8	WEST	Wd F	Ex	SPD	Ex	O-S	39	5%	Berliner—CM-4
136	110	45				80	550	12	Wl-ST	Wd F	Ex	SPD	B	O-S	Apl	5%	Berliner—CM-5
90	80	50	460	80	10,000	55	325	9	Wl-ST	Wd F	Yes	SC PD	Ex	RC	Apl	Yes	Bird Wing—No. 6
132		57	800	16 5	15,100	140		25	Wl-ST	Wd F	Yes	S	S	O	27		Boeing—40-B
129		57	800	25 5	12,000	140		20	Wl-ST	Wd-F	Yes	S	S	O	54		Boeing—40-C
115		59	1,000	18 5	12,000	80		20	Wd	Wd-F	Yes	De					Boeing—B-1E
95		52			12,000	40			Wd	Wd F	Yes	DeD			23		Boeing—B-1D
110	95	40	650		14,000	45	800	6 5	Wl-ST	Wd F	Yes	SPD	Op	RD	134	5%	Bourdon Kitty Hawk
128	115	45	900		15,500	80	550	9 5	Wl-ST	Wd F				RC			Breese
120	95	50		45	13,500	70		15	Wl-ST	Wd F	Yes	SC	Yes	OS	33		Buhl Airsedan
139	115	45	900	15	14,000	90	700	14	Wl-ST	Wd-F	Yes	SP	Yes	OS	46	5%	Buhl Special Airsedan
110	90	40	600	25	11,000		800	7	Wl-ST	Wd F	Yes	SP	Yes	OS	Apl	5%	Buhl Junior Airsedan
125	110	45—50	1,000			42	800	10	Wl-ST	Wd-F	Yes	SPD	Ex	RAR	Apl	5%	Cessna Aircraft Co.
125	115	45	1,000			42	800	10	Wl-ST	Wd-F	Yes	SPD	Ex	RAR	Apl	5%	Cessna Aircraft Co.
150	125	45—50	1,000			42	400	12	Wl-ST	Wd-F	Yes	SPD	Ex	RAR	Apl	5%	Cessna Aircraft Co.
104	85	36	550		10,000		400		Wl-ST	Wd-F	Yes	S	No	RC	53		Command-Aire
101	85	40	460		11,500	50	607	7	Wl-ST	Wd-FD	Yes	S-PC	No	RAR	40	5%	Curtiss—Robin
85	75	46	560		15,000	15	375	3	Wl-ST	Wd-FD	Yes	SC	No	RAR	15	5%	Driggs—Dart II
96	80	25	590		10,000	20	800	4	Wl-ST	Wd-F	Yes	SC	No	Elias			Elias—Aircoupe
105	90	40	700		10,500	20	425	5	Wl-ST	Wd F	No	SC	Yes	OS	Apl	Yes	Fairchild—21
130	104	50	800		12,400	70	600	12	Wl-ST	Wd-F	Yes	SC	Yes	OS	Apl	Yes	Fairchild—41
150	118	55	1,050		17,000	100	900	21	Wl-ST	Wd F	Yes	SC	Yes	OS	89	Yes	Fairchild—71
125	105	40				84	750	10	Wl-ST	Wd	Yes	SC	Yes	Arl			Federal Aircraft—CM-1
111	90	35	950		16,000	24	350		Wl-ST	D-Wd-F		SPD	No	O	122		Fleet Model 1
126	105	46	830		14,000	70	630	12	Wl-ST	Wd-F	Yes	SCD	Yes	RC	Apl		Fokker Universal
138	118	54	1,000	15	18,000	126	735	20	Wl-ST	Wd-F	Yes	SCD	Yes	RAR	52	5%	Fokker Super Universal
140	118	55	1,400	10	15,000	360	765	40	Wl-ST	Wd-F	Yes	DeCD	Yes	RAR	95		Fokker—F-10
115	90—95	37	750	18	16,000	64	600	12	DR-F	Wd-F	Yes	SCP	Ex	O-S	107	5%	New Stand. Aircraft Corp.—D 24
110	90	40	650		12,150	40	540		Wl-ST	Wd-F	Op	S	S	RC	117	Yes	General—Aristocrat
135	115	50	950	20	16,000	140	600	21	D-cor	D-cor	Yes	De	Yes	Arl		5%	Hamilton—H-45
140	120	55	1,000	16	18,000	140	600	23	D-cor	D-cor	Yes	De	Yes	Arl		5%	Hamilton—H-47
70	65	32	200			5 5	120		R-ST	Wd-F	No	SC	No	RC			Heath—Parasol
100	87	35	800		10,500	40	450		Wd	Wd-F	Yes	S	Ex	O	35		International—F-17
125	110	40	850		14,000	67	500		Wd	Wd F		S	Sd	O	Apl		International—F-18
95	85	46	650	35	11,000	65	500	12	ST-D	Wd-F	Yes	DeD	No	OC	Apl	5%	Ireland—Neptune
90	75	28	800	65	12,000	8	300	1 7	Wd	Wd-F	Yes	SC		RC		6%	Irwin—M T-8
151	150	57	1,450		17,400	500	750		Wl-ST		Yes		Yes	O			Keystone—Patrician
112		57	570				500		Wl-ST	Wd-F							Keystone—Pathfinder
102		34	548		12,000		400		Wl-ST	Wd F	Ex	SD	No	RC	19	5%	Kreider-Reisner—Challenger
130		40	1,350	10		80	500		DT, S	Wd F		SPA					E. M. Laird—Commercial
100		35	900			42	500		Wl-ST	Wd-F					28		Lincoln—Page
155	110	50	1,000	16	15,900	100	700	10	W mno	Wd-F	Yes	SC	H	RC	Apl	5%	Lockheed—Vega
167	135	55	1,460	10	17,250	100	1,000	18	W mno	Wd-F	Yes	SC	H	RC	Apl	5%	Lockheed—Air Express
150	105	55			15,000	140	550	28	Wd D	Wd-F-D	Yes	DeD	No	Arl	90		Loening—Amphibian
126	108	49	1,000		16,000	83	700	10—11	Wl-ST	Wd F		SC	B	Grs	25	Yes	B. F. Mahoney—Ryan B1
135	115	48	800		16,500	150	1,000	21	Wl-ST, D	D	Yes	DDeCP	B	Arl		5%	Allmetal Flamingo
90	75	35	700						Wl-ST	Wd-F	Yes	S Pl		RAR			Mono Aircraft—Monocoupe
100	85	35	650		10,000	22	350	4 6	Wl-ST	Wd F	No	S Pl	No	Grs	95	Yes	Mohawk—Pinto
90	80	50	800		11,000	10	360		Wl-ST	Wd-F		SC	No	RAR	Apl		Szekely Flying Dutchman
103	90	38	650	25	15,500	42	465	7	Wl-ST	Wd-F	Yes	SPD	Yes	F	Apl	Yes	Paramount Cabinaire
100	80	35	800		12,500	58	490	9	Wl-ST	Wd-F	Ex	SPD	Ex	RC	36		Pheasant—H10
136	105	45	1,000		11,000	60	800		Wl-ST	Wd-F	Yes	S	Yes	Arl	18	5%	Pitcairn—PA 5
129	110	45				76			Wl-ST	Wd-F	Yes	S		Arl			Pitcairn—PA-6
101	82	45				35	400		Wl-ST	Wd-F		S		Grs			Pitcairn—PA-4
114	96	59	750		12,000	110	540	17	D-cor	D-cor	Yes	DeDC	Yes	P			Prudden—S-E-1
95		45				42			Wd-D	Wd F		DeCP					Richmond Airways—Sea Hawk
122	112	58	650		15,000	570	790	50	DOR, B	DOR, B		DeD	Hy	RDO	Apl	5%	Sikorsky—S37
125	118	55	850	15	19,000	200	500	36	Wd D	DOR, B	Yes	DeD		DOB	60	5%	Sikorsky—S38 Amphibion
125	110	40	1,000	17	16,000		1,250	5 5	Wl-ST	Wd F	Yes	S				5%	Simplex—Red Arrow
104	95	38		15,000		40	450		Wl-ST	Wd F		SD		HyC			Starling
110	90	58	625		12,000	50	500	7	Wl-ST	Wd-F	Yes	PC	St	RHy	Apl	5%	Stearman—C-3 K
150	110	41	1,000		16,000	65	620	11 5	Wl-ST	Wd F	Yes	PC	St	RHy	Apl	5%	Stearman—C-3-B
125	105	36	900		14,000	90	750	11	Wl-ST	Wd F	Yes	DeD	Sd	Hy	74		Stinson—SM 1 D
110	90	40	800		13,500	42	800	7	Wl-ST	Wd F	Yes	DS	Sd	Hy	48	5%	Stinson—Junior
115	100	37	800	12 5	16,000	50	600	8	Wl-ST	Wd F	Yes	DS	No	RC	73	Yes	Spartan—C-3
114	100	55			14,000	235	540	50	D-cor	D-cor	Yes	DeD	St	O			Stout—Ford—4AT
100		35	800			36	800		Wl-ST	Wd F				RC	21		Swallow—Commercial
110	100	38	850			55	800	6	Wl-ST	Wd-F	Yes	SP		RAR		Yes	Taylor Bros.—Chummy
						50			Wl-ST	Wd-F		S					Texas—Temple
						120			D-cor	D-cor		De		Grs			Thaden Metal—T 1
100		42			12,000	42	410	8	Wl-ST	Wd-F	Yes	SPC	No	RC	50		Travel Air—2000
150		45			20,000	60		12	Wl-ST	Wd-F	Yes	SPC	No	RC	32		Travel—4000
128	107	50	700		13,500	76	650	12	Wl-ST	Wd-F	Yes	DeD	Yes	O	Apl		Travel Air—6000
115	100	43	800	27	14,000	32	500	6 4	Wl-ST	Wd F	Yes	SPD	Yes	OS	119		Wallace—Touroplane—Model "B"
97	90	35	800		14,000	40	350	8	Wd WIS	Wd-F	No	S		C	Apl	5%	Whites—Rumpring Bird
95	85	50	800	30	12,000		500	8	Wl-ST	Wd F	No	SC D	No	RC	No	5%	Western—King Bird

D WING CONSTRUCTION
- P —Plywood cover
- R —Riveted
- S —Steel
- T —Tubing
- Wd —Wood
- Wl —Welded
- L —Lockheed
- O —Optional
- S —Saunders
- Std—Standard

LIGHTS
- N —Navigation lights
- Op—Optional

CONTROL
- A —Arens
- C —Cables
- D —Dual
- De—Wheel
- P —Push rods
- S —Stick
- Pl —Pedal

SHOCK ABSORBER
- Arl —Aerol
- C —Cord
- D —Compression
- Grs—Gruss
- Hy —Hydraulic
- O —Oleo
- P —Pneumatic
- R —Rubber
- RAR—Rusco Aero Rings
- S— —Coil Spring
- T —Trossbous

TYPE CERTIFICATE
- Apl—Applied for and is pending

GUARANTEE
- N —New

MANUFACTURERS' SPECIFICATIONS ON ENGINES AVAILABLE FOR COMMERCIAL USE AS COMPILED BY *AVIATION*

THE TABLE BELOW IS BELIEVED TO BE ACCURATE BUT *AVIATION* DOES NOT ASSUME RESPONSIBILITY FOR THE FIGURES GIVEN

This table will appear monthly and corrections and suggestions are invited

Columns: Manufacturer or Agent; Engine; Cooling System; Cylinder Arrangement; No. of Cylinders; No. of Cycles; Propeller Drive; Rated Hp. and R.P.M. at Sea Level; Maximum Hp. and R.P.M. at Sea Level; Weight Dry Without Hub or Starter; Weight Per Rated Hp.; Bore and Stroke (in.); Compression Ratio; B.M.E.P.; Displacement (Cu. In.); Frontal Area (Sq. Ft.); Diameter of Mounting Ring or Distance Between Bearers (in.); Height or Overall Diameter (in.); Length Without Starter (in.); Guaranteed Fuel Consumption at Rated Hp. Lb./Hp. Hr.; Oil Consumption Lb./Hp. Hr.; Valve Mechanism; Cylinder Construction (See Key); No. Intake Valves Per Cylinder; No. Exhaust Valves Per Cylinder; Make Spark Plugs Supplied with Engine; Type of Ignition; Make Ignition; No. Carburetors; Make Carburetors; Make Starter; Are Exhaust Manifolds Provided; Shipping Weight Crated; Dept. of Commerce License; Cost at Factory

MANUFACTURER OR AGENT	Engine	Cooling System
Aircraft Engine Co.	Comet	A
Allison Engineering Co.	V1410	A
Allison Engineering Co.	VG1410	A
Allison Engineering Co.	V1600	W
Anzani Machine Co.	Anzani 47R	A
Curtiss Aeroplane & Motor Co.	OX 5	W
Curtiss Aeroplane & Motor Co.	OXX6	W
Curtiss Aeroplane & Motor Co.	C-6A	W
Curtiss Aeroplane & Motor Co.	D12	W
Curtiss Aeroplane & Motor Co.	Conqueror	W
Curtiss Aeroplane & Motor Co. Inc.	Geared Conqueror	W
Curtiss Airplane & Motor Co.	Chieftain	A
Curtiss Airplane & Motor Co.	Challenger	A
Dayton Airplane Engine Co.	Bear	A
Hall Mfg. Co.	H 526	A
Irwin Aircraft Co.	Irwin 79	A
Kinner Airplane & Motor Corp.	K 5	A
Kimball Aircraft Corp.	Beetle Model K	A
Le Blond Aircraft Engine Corp.	Model 60	A
Menasco Motors Co.	B 2 Salmson	A
Michigan Screw Co.	Rover	A
Packard Motor Car Co.	1A 2775	W
Packard Motor Car Co.	3A 1500	W
Packard Motor Car Co.	3A 1500	W
Packard Motor Car Co.	5A-1500	W
Packard Motor Car Co.	3A-2500	W
Packard Motor Car Co.	5A-2500	W
Pratt & Whitney Aircraft Co.	Wasp	A
Pratt & Whitney Aircraft Co.	Hornet	A
Pratt & Whitney Aircraft Co.	Geared Hornet	A
Quick Motors Co.	Quick Radial	A
Siemens & Halske A. G.*	Siemens Sh 15	A
Siemens & Halske A. G.*	Siemens Sh 14	A
Siemens & Halske A. G.*	Siemens Sh 12	A
Spartan Aircraft Co.	Walter 5	A
Spartan Aircraft Co.	Walter 7	A
Spartan Aircraft Co.	Walter 9	A
Szekely, O. E., Corp.	SR 3	A
Tips & Smith, Inc.†	Super-Rhone	A
Velie Motors Corp.	Velie M5	A
Warner Aircraft Corp.	Scarab	A
Wright Aeronautical Corp.	Whirlwind Five	A
Wright Aeronautical Corp.	Whirlwind Seven	A
Wright Aeronautical Corp.	Whirlwind Nine	A
Wright Aeronautical Corp.	Whirlwind J5	A
Wright Aeronautical Corp.	Cyclone R1750	A

*— Engines of foreign manufacture
†— Rebuilt
a— Applied for
A— Air cooled
Aa— Aluminum alloy
Ae— Aeromarine
Al— Aluminum
AS— Ansani or Scintilla
Au— Automatic
B— Battery ignition
BR— Robert Bosch
Bs— Scintilla booster magneto
C— Cast iron
Ch— Champion
Cylinder Construction
first—head
second—walls or waterjacket
third—sleeve, if any
D— Direct
De— Delco
Du— Duplex
Dx— Dixie
DM— Dual Magneto
Ec— Eclipse
E— Ensign
Ex— Extra
G— Geared
G1— 5.3 epicycloe gear
G2— 2:1 reduction gear
GE— General Electric
H— Hexagonal
I— Inverted
Ic— Cast Iron
L— Cylinders in line
Mo— Monel
M— Magnetic
NI— Nickel Iron
N— No
O— Own
Ohc— Overhead cam
prr— Push rods and rocker arms
Rad— Radial
Rad S— Staggered Radial
Sc— Scintilla
Sg— Stromberg
Sg1— Stromberg NA-U5 duplex
Sg2— Stromberg NAS-5E
Sm— Sum
So— Solex
Sp— Splitdorf
S— Steel
U— U.S.L. Electric
V— Vee
W— Water cooled
Wi— Winfield
X— Extra
Y— Yes
Z— Zenith

AVIATION

The Oldest American Aeronautical Magazine

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AERONAUTICAL ENGINEERING SECTION

CONTENTS

Slots and Spins

Abstracts from a Paper Read by Lieut. Carl Harper, U. S. N., at the S. A. E. Sessions Held During the Detroit Aircraft Show

By Lieut. Carl Harper

A SPIN is a maneuver consisting of a combination of roll and yaw, with the longitudinal axis of the airplane inclined steeply downward The airplane descends in a helix of large pitch and very small radius, the upper side of the airplane being on the inside of the helix, and the angle of attack on the inner wing being maintained at an extremely large value

In normal flight a roll will raise the tip of the lower wing due to the extra lift from the increased angle of attack The opposite is true at stall and beyond Further the vector on the nearly stalled high wing is forward This causes a yaw which increases the rate of roll

Autorotation

Mount a wing on an axis along the direction of the wind Below stall a roll will damp out Above stall the wing will start to rotate and will keep up this rotation until it reaches a steady state This rotation has a maximum value about 25 deg or 30 deg If it has another rolling action added it will speed up and reach a faster steady state. Above 40 deg it again becomes stable However, with zero stagger it may pass into a second high rotation rate and stay there up to very large angles

A plane may fall into a spin after the wings have stalled This may result from a simple stall or an unnatural attitude from an incompleted maneuver The ailerons are ineffective and if they are of the old conventional type their drag aids the spin when the pilot tries to pick the wing up An inexperienced pilot may hold the stick back to bring the nose up because the nose is down relative to the horizon although it is up relative to its flight path Of course, this keeps the plane in the spin The decreased velocity of the low wing causes it to lose more lift.

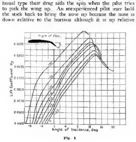

Fig 1

The majority of military and civil airplanes can be forced into vicious spins Once in a spin the pilot should immediately push the stick all the way forward as soon as he feels a force tending to keep the stick back The reversal of stick force is a direct indication of a peculiar or flat spin The rudder should be set opposite to the spin and held there until the plane comes out This reversing of the controls—stick forward and opposite rudder must be held until rotation ceases Sometimes a number of turns continue before the plane finally emerges The rudder must be neutralized and the plane brought out of its dive Otherwise a stable inverted flight condition or even an inverted spin may result.

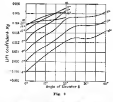

Fig 2

Forces Which Keep Plane in Spin

Tests as early as 1917 made on single cambered surfaces showed at 20 deg incidence that the throw from zero degrees to 30 deg on a trailing edge flap had little added effect The lift increase was in the order of 10 per cent. Fig 1

Tests made at the Navy Bureau of Aeronautics Wind Tunnel on a conventional stabilizer and elevator of recent design (double cambered surface) showed at 20 deg incidence that the throw from zero deg to 20 deg on the elevator gives a lift increase in the order of 20 per cent This same throw at 8 deg incidence gives an increase of 250 per cent and at 4 deg incidence an increase of 400 per cent Fig 2

Recent tests on a complete airplane model show that the tail plane is approaching a stall in the region of 50 deg incidence for the airplane A change of 20 deg in elevator throw gave only a 30 per cent change in pitching moment for the entire model at 50 deg incidence of the model

To obtain at 30 deg incidence the same force as at 10 deg incidence of the airplane the elevator must be 30 per cent larger and the rudder 50 per cent This applies to an airplane of the conventional type

Above 45 deg incidence a spin may be easily such that the elevators are no longer effective

The fin and rudder are blanketed by the stabilizer and elevator The whole tail is blanketed by and is acting in the disturbed air from the rapidly rotating wings The fuselage shields the controls particularly the fin and rudder at large angles of incidence

A cylindrical fuselage has considerably less weathercock effect than one with straight sides

Roll and Yaw

In stalled flight where roll and yaw are present, roll causes an air reaction which increases the rate of roll and yaw Yaw further increases the rate of roll

Yaw

Simple yaw experiments in the wind tunnel at high angles of incidence fail to give results which may be assumed to obtain for autorotation at these same angles Since such comparison will not hold it is necessary to test a model under rotation

Side Slip

In side slip there is a loss in pitching moment that may be partially accounted for by the fuselage blanketing the horizontal tail surfaces on the inboard side Wind tunnel tests indicated by a comparison of an airplane model with positive stagger and one with zero stagger that a biplane with positive stagger will exhibit autorotative properties similar to a biplane with zero stagger This happens when the side slip is as much as 10 deg or 20 deg outward This outward side slip has been observed particularly where the spin is in a direction opposite to the rotation of the propeller The rolling couple due to side slip beyond stall is large and is no longer a linear function of any dihedral angle of the wings

Intertia Couple

In a spin there are dynamic forces present The largest of these forces is an inertia couple tending to raise the nose independent of the direction of rotation This couple is a product of the centrifugal force due to rotation by the moment arm of this force The inertia couple may be evaluated to

$$\tfrac{1}{2}\,\Omega^2 \sin 2\alpha\,\Sigma\,(mx^2)$$

It will be noted that this moment increases roughly as the square of the angular velocity of the spin and with incidence up to 45 deg

In wind tunnel tests and in full scale experiments it has been found that this couple has exceeded the available elevator control moments at 30 deg incidence A high wing monoplane has particularly large inertia forces

Gyroscopic Couple

Another dynamic force in a spin is the gyroscopic couple due to the gyroscopic force of the propeller This couple may be evaluated to

$$I\,\omega\,\Omega \sin \alpha$$

This couple increases the spin when the spin is in a direction opposite to the rotation of the propeller Therefore in a left spin in the conventional airplane in this country it is a question whether the engine is of value to help bring the plane out of the spin The gyroscopic forces may be greater than the added effectiveness of the tail surfaces working in the propeller slipstream The use of heavy metal propellers with adjustable hubs has increased this gyroscopic force

α is the angle of incidence at the center of the wing
Ω is the rate of rotation in radians per second
m is mass
x is distance from the center of geavity
I is the moment of inertia of the propeller
ω is the rate of rotation of the propeller

Values in a Spin

The acceleration which holds the pilot in his seat in a spin may become as great as $4g$ This value is smaller in fast flat spins The force increases as the

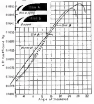

Fig 3

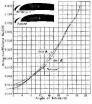

Fig 4

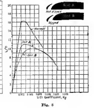

Fig 5

pilot is further from the center of gravity The lateral acceleration is only a fraction of g

The vertical drop averages about 200 ft. in one turn

The time of a turn is from one to four seconds

The radius of turn is from a few feet to several times the wing span

The angular velocity of spin is from one to four radians per second

Bad Design Features

In 1924 it was recognized abroad that control areas must be increased This increase in control areas was primarily necessitated by the use of higher wing loadings In this country engineers had more or less followed Navy practice. The Navy used relatively large control surfaces for landplanes since these large control surfaces were necessary whenever floats were substituted for land gear Also the Navy needed larger control areas for its lower specified landing speeds This has delayed somewhat the day of reckoning in this country

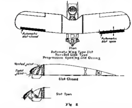

Fig 6

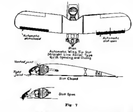

Fig 7

Zero Stagger

A decrease in positive stagger decreases the nosing over pitching moment at high angles of incidence This is a result of the blanketing effect of the upper wing

Small Gap Chord Ratio

A small gap chord ratio causes interference between the wings with a consequent decrease in the nosing over moment at high angles.

Center of Gravity Aft

The center of gravity should never be further aft than 35 per cent of the mean aerodynamic chord The forward position of the center of gravity not only aids the pitching moment to recover but it helps to decrease the nosing up inertia couple

High Wing Loading

With high wing loadings dynamic forces grow into very powerful inertia couples that are difficult to damp out by the use of controls unless this has been provided for in design It has been suggested that 25 per cent be added to the area of the tail surfaces that have been determined for normal flight, to overcome bad spinning tendencies

Wind Tunnel Tests

The usual wind tunnel tests of a complete airplane model should be carried up to incidences of 90 deg The model should be tested on a rotating arm to determine its spinning characteristics

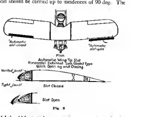

Fig 8

Physiology of the Spin

The inner ear comprises a membranous labyrinth containing a fluid called endolymph This endolymph is actually set in movement in a spin after three turns and this motion persists after the spin has stopped

The endolymph impulses are transmitted over the auditory nerve to the brain and then down through the optic nerve to the eye These impulses drive the eye to one side, a superimposed corrective effort pulls the eye to the opposite side and an oscillation is set up The effect is such that after a number of turns even though pilot has brought himself out by the use of his controls, the oscillation requires time to dampen out The pilot's senses tell him he is still spinning as a result he is apt to over control and fall into a spin in the opposite direction

The above condition after a few turns does not grow worse with the number of turns However an equally dangerous effect and one that does grow with the number of turns is anemia of the brain The heavy centrifugal force drains the blood from the brain and too

prolonged results in haziness, dizziness, and unconsciousness The viscera are affected in fact soreness of the abdominal muscles will persist for a couple of days after many prolonged spins are indulged in

Add to the above the physiological mechanics whereby the forces make the pilot four times his own weight Parachute escape then is impossible unless there is some sort of trap through the bottom of the fuselage Studies of this escape are now being undertaken Ten turns have been set as a limit abroad and seems reasonable for a fast spinning military plane Of course, the pilot changes his accommodation from constant spinning practice and by keeping his eyes centered inside the cockpit Nevertheless a full scale test is a poor way to try out small changes and their relation to spinning The wind tunnel should do this with full scale as a final check

Slots

Several years ago the United States Navy entered into negotiations with Handley-Page Ltd , for the purchase of the rights to use the Handley-Page Slots Negotiations have been concluded whereby upon the payment of a stipulated royalty the United States Army and Navy install this slot on service airplanes

The Purpose of the Slot

The nature of wing lift near stall is such that most of this lift results from a lowered pressure in the high velocity air where the streamlines are crowded together on the upper surface near the nose of the wing In a conventional wing section this flow breaks at about 15 deg incidence the wing burbles and loses lift and takes on a big increase in drag

With a wing slot there is housed in the leading edge of the wing a little airfoil so pivoted that its own air forces cause it to move forward when the incidence of the main wing approaches 10 deg Through the opening formed between the little wing and the mother wing high speed air forces itself over the upper surface of the mother wing and delays the burble point until the wing incidence is nearly double that of normal stall At the same time the lift per square foot has increased from 60 per cent to 80 per cent

The auxiliary airfoil furnishes part of this lift and it stalls a little ahead of the mother wing

In a biplane combination the slot allows advantage to be taken of the full lift resulting from the high stall angle of the lower wing of the biplane combination. Figs 3, 4, 5

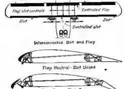

Fig. 9

Types of Slots

Figs 6 7, 8, illustrate the link, the roller, and the gate, types of slots Fig 9 shows a controlled slot

Automatic Slots

Automatic slots are used to maintain stability laterally beyond normal stall This assists in control beyond normal stall and the increase in stability is of advantage in landing on aircraft carriers or in restricted areas In a forced landing to approach with no engine gravity must furnish the power to overcome the drag at high angles of incidence For control the pilot must be flying at an angle less than stall else the plane may turn over and dive toward the ground in a spin. With slots, brakes can be used to more advantage because wheels can be put on the ground early Since normally the pilot levels off and the plane glides along above the ground while flying speed is being lost However oleo legs should be built to withstand this drop if the landing gear is to be saved in such an emergency landing

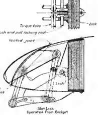

Fig 10

Locks are being installed on automatic slots in use by the Navy The pilot is therefore able to nose his plane over until it has an angle of incidence such that the vectors on the auxiliary airfoil close the slots and a lever controls the mechanism locking the slots closed Fig 10

Controlled Slots

For the heavier types of Naval airplanes, particularly large bombers, torpedo planes and flying boats, a slot is incorporated along the whole length of the upper wing Connected to this slot is a trailing edge flap which is pulled down as the slot is opened The slot is not automatic but is controlled both in opening and in closing by the pilot The trailing edge flap as it is pulled down makes a fictitious angle of incidence which permits advantage to be taken of the high lift from the slot at a normal landing angle

For lateral control a spoiler has been placed just to

the rear of the upper slot opening. This spoiler was first proposed by the Navy in 1920. As the spoiler goes up it destroys the lift due to the smooth airflow over the upper surface and at the same time adds drag in the direction of turn. Fig. 11.

Slot Design

Features of primary importance in designing a slot fall under the headings of shape, chord, point of rotation, which point of rotation depends on the vectors of the

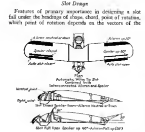

Fig. 11

little airfoil and the proper venting. The span of the auxiliary airfoil on an automatic wing tip slot should be at least the aileron span. Its location should be in front of the aileron. It was thought until very recently that it would be of advantage to place the slot so that its middle occurred at the inboard edge of the aileron, but recent tests indicate that it should be kept outboard. Figs. 12, 13.

The most important feature of a slot installation is its fit. A slot must be a hand tailored fit for a particular wing curve. Both slots must lift an equal amount and tests have shown that an $\frac{1}{8}$ in. difference in the upper

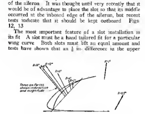

Fig. 12

opening of the slot gap makes or mars the slot. Both slots must open at a low airspeed in order not to interfere with climb. Both slots must open at the air-speed. Fig. 14.

Wind Tunnel Hook-up

In order to tie together a research program between the

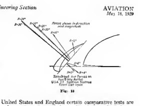

Fig. 10

United States and England certain comparative tests are to be run in various wind tunnels. An actual wind tunnel model after having been tested at Farnboro, The Royal Aircraft Establishment, and at Toddington, The National Physical Laboratory, and at the Handley Page tunnel, is to be shipped to this country and tested in the Navy Bureau of Aeronautics wind tunnel.

The National Advisory Committee for Aeronautics has already conducted preliminary pressure distribution tests in its density wind tunnel.

Investigations of a particular slot to a given airfoil are being conducted by the Navy and by interested contractors. Fig. 15.

Slots in Tests

The O2U (Vought Corsair) has been selected to try out various types of slots.

It was put into spins both normal and flat and the slots unlocked in the spin. The slot opened with a bang on the low wing and brought the plane out of the spin in

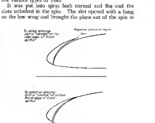

Fig. 14

a half turn. From a dive the slots can be opened full at 140 m.p.h. airspeed by jerking the control stick back with both hands. In any sort of gradual pull out from a dive the slot does not open until near its normal opening airspeed.

Special oleo gears which will absorb high vertical velocities are being worked on.

Ice Formation on Slots

Flying from Anacostia toward New York on Nov. 20 about noon, O2U-1 airplane A-7222 was climbed to 10,000 ft. The cloud level was just below 10,000 ft. and

these clouds were 5,000 ft. thick. After flying for about 10 min. at this altitude, the plane was headed in a flat power glide down through the clouds. In a short while ice began to form, the windshield being completely covered with thick white frost and ice formed quickly on the struts, wires, and on the leading edges of the wings.

WIND TUNNEL TESTS

Airfoil Section—Clark Y

Range of test	3 degrees minimum and 16 degrees maximum.
Model size	15" chord x 20" span.
Airspeed	30, 40, 50 and 60 m.p.h.
Place of test	Navy Bureau of Aeronautics Tunnel.
Result of test	Obtained angles at which slot opens and closes at three positions of adjustment.

Note. Airfoil free to move and adjusted and tested at all three positions provided.

Airfoil Section—N22

Range of test	Zero degrees to 18 degrees at 3-degree intervals.
Model size	15" chord x 20" span.
Airspeed	40 m.p.h.
Place of test	Navy Bureau of Aeronautics Tunnel.
Result of test	Obtained lift, drag, pitching moment, desired moment and center of pressure distance.

Note. Airfoil fixed in both "open" and "closed" positions.

Airfoil Section—N22

Range of test	Full range at one position of adjustment and from 12° to 21° in both "open" and "closed" positions at other adjustment positions.
Model size	12" chord x 20" span.
Place of test	Navy Bureau of Aeronautics Tunnel.
Purpose of test	To observe airflow through slots.

Note. Airfoil adjustable and also free to move.

Airfoil Section—N22

Model size	6" chord x 36" span.
Place of test	Navy Bureau of Aeronautics Tunnel.
Purpose of test	To obtain best position of slot for maximum lift of entire airfoil with the slot in "open" position.

Note. Airfoil adjustable by means of wire support.

Airfoil Section—Curtiss C-72

Model size	15" chord x 20" span.
Place of test	Navy Bureau of Aeronautics Tunnel and Curtiss Tunnel.
Purpose of test	To select type of slot for F7C plane.

Airfoil Section—H A F 31

Place of test	National Advisory Committee for Aeronautics Density Tunnel.
Result of test	Obtained flat lift curve at and beyond the stall and pressure distribution.

Airfoil Section—Boeing 103-A

Model size	12" chord x 20" span.
Place of test	Navy Bureau of Aeronautics Tunnel—Test not completed.

Note. Airspeed through the slot is that measured at the upper gap.

Fig. 13

An appreciable amount of snow was encountered on proceeding down. The plane was leveled off over Aberdeen for a few minutes at about 4,500 ft. Ice had formed to such an extent that it almost doubled the width of the streamline wire in the direction of the wind. The plane was brought down to 1,000 ft. and in about 15 or 20 min. the ice had entirely disappeared from the plane.

It is not known just what the temperature under which this formation took place was, no thermometer being in the plane, however, it was noticeably very cold at 10,000 ft.

This particular plane was equipped with the Handley Page slot of the link type and the ice apparently did not affect the operation of the slot, since the slots opened full out when the machine was brought to a stalled position at 4,500 ft.

On Feb. 16, 1929, the slots on the F7C (Curtiss Sea Hawk) were readjusted as to venting in order to delay the opening of the left slot. The pulleys were thoroughly oiled and checked. A preliminary flight showed that the slots were opening fairly satisfactorily. Twenty pounds of shot was added in the luggage compartment to help correct the plane's nose heaviness (due to weight of slots). At 10,000 ft. the plane was put into a snap stall and whipped into a power spin with full left rudder at 1,200 r.p.m. After a turn and a half the throttle was gradually pulled back. The spin was very fast and smooth. At 7,000 ft. the slots were unlocked and the controls freed. (The controls had been held all the way back with full left rudder.) Instead of snapping out, the spin tightened and its rate increased. The left slot had opened but the right remained closed. The stick was then pushed forward and the right rudder applied. The right slot then opened but not all the way and the nose came up and the spin became flat. With throttle opened the spin seemed to slow up but the plane failed to come out. The throttle was then closed. In the flat spin the slots came back two or three times to within a half closed position in fact an attempt was made to lock them but they were not back far enough to engage the lock. The stick was pulled back and hard left rudder was applied. The plane seemed to go into a normal spin again. Next the stick was pushed forward and held. A small amount of right rudder was applied and the stick was pulled slowly back and pushed forward again. After holding in that position with no result the stick was brought back, the throttle was opened and the stick was pushed slowly all the way forward and held there. The plane came out of the spin partly on its back at 3,000 ft. The plane was then leveled off. After landing, an examination showed that the left slot could operate much more freely than the right one. There was considerable friction on the right slot. To balance the action, friction must be reduced to a minimum.

The angle of attack for the inside wing must have been such that the drag set up at this angle, which was beyond the slotted stall, had more effect than the lift.

The pilot gets a little more reaction in a single seater spin because he is back of the center of gravity. The weight of the slot on each wing, of course, makes the spin worse.

During this spin the centrifugal forces were very heavy and it was very difficult for the pilot to raise his arm to unlock the slot. After emerging from the spin the ground appeared to be going around very fast, although

PERMISSIBLE AIRCRAFT MANEUVERS

Maneuver	Fighting Planes	Diving Bombers[1]	Observation Planes[2]	Scouting Planes[2, 3]	Torpedo Planes and High Bombers	Patrol Planes	Transport Planes	Training Planes
Loop					0	0	0	
Slow roll			0	0	0	0	0	0
Fast roll				0	0	0	0	
Double roll			0	0	0	0	0	0
Chandelle					0	0	0	0
Immelman					0	0	0	
Outside loop	0	0	0	0	0	0	0	0
Split S						0	0	
Wing over						0	0	
Vertical turns								
Inverted flight	No. 4	No. 4	0	0	0	0	0	0
Falling leaf					0	0	0	
Spins (not over 3 turns)					0	0	0	0
Prolonged spins			0	0	0	0	0	
Taylor turn				0	0	0	0	
Steep dives				0	0	0	0	

[1]To include all types assigned to diving bomber squadrons.
[2]No acrobatics when equipped with radio.
[3]To include all amphibians two and three seaters.
[4]Pending engine development.

Fig. 16

the plane was flying normally. The sun and everything appeared rather dark and then the sun became a pale lemon color, quickly changing to gray and then bright again. During part of the spin the centrifugal forces are so high that it would be practically impossible to get out to use a parachute. In the latter part of the spin the centrifugal forces have been at work for such a period that so much blood is drawn from the head, chances of parachute escape are further lessened

U. S. NAVY PLANES WITH HANDLEY PAGE SLOTS

Model	Airfoil Section	Wing Cord	Type of Operating Mechanism: Vertical Parallel Link	Curved Line Roller	Horizontal Parallel Beam	Adjustable	Positive Action	Automatic Action	Maximum Locked	Slot Conn. to Flap	Aileron Conn. to Spoiler
NY2	Clark Y	5'-0"	Yes			Semi three positions		Yes	No		
NY2	Clark Y	5'-0"	Yes			Semi three positions		Yes	No		
NY2	Clark Y	5'-0"	Yes			Yes		Yes	Yes		
NY2	Clark Y	5'-0"	Yes			Yes		Yes	Yes		
O2U1	N22	5'-5"	Yes			Semi three positions		Yes	Yes		
O2U1	N22	5'-5"	Yes			Yes		Yes	Yes		
O2U1	N22	5'-5"	Yes	Yes		Yes		Yes	Yes		
O2U1	N22	5'-5"	Yes			Yes		Yes	Yes		Yes
O2U1	N22	5'-5"	Yes			Yes		Yes	Yes	Yes	
T4M1	M24	6'-7"			Yes	Rear end only	Yes				
PN11	N22	9'-0"	Yes, modified			Rear end only	Yes			Yes	
F3B1	103-A	5'-9"	Yes			Semi three positions		Yes	Yes		
F7C1	C-72	5'-3"		Yes		Yes	Yes		Yes		

Fig 17

Personnel of the Curtiss Company, who were observing this spin, stated that the plane spun twice as fast as any spin they had seen and they counted thirty turns before the flat spin developed. They stated that from the ground the plane appeared to be doing maneuvers they had not seen before and the spin was peculiar and flat, and they did not think the plane was going to be gotten out.

Every representative airplane manufacturer in this country has had a recent model which has exhibited vicious or peculiar spinning qualities. This has been also true abroad. A plane is said to have abnormal spinning qualities when it fails to promptly emerge from a spin of five or more turns upon neutralizing its controls.

For structural and aerodynamic reasons the Navy has seen fit to issue a chart which sets forth the permissible maneuvers to be allowed its various types. The spin as a military maneuver is open to serious question. Certainly a prolonged spin is not only a steady target for a plane diving on it, but the pilot who emerges from a prolonged spin is not as physically acute as when he entered it.

A spin should be taught and practiced but should be limited to four or five turns under ordinary conditions of flying. Fig 16.

Recovery from Spins

There are certain maneuvers that the slot does not interfere with, such as rolls and loops, but to do a flat spin the slots may be left locked. The pilot can unlock them in a spin and expect them to aid his recovery. They have brought the O2U (Vought Corsair) out of vicious spins both normal and flat, when unlocked, after being in the spin.

They keep the plane out of trouble in blind flying. If a wing reaches its normal small angle and one side starts to drop the slot gives increased lift as the angle of attack of the falling wing increases. This raises the wing to restore it to its horizontal position.

TECHNICAL PUBLICATIONS RECEIVED

N A C A Technical Memorandum No 509, the Transformation of Heat in an Engine, by Kurt Neumann, from Geiger and Scheel's Handbuch der Physik, Chapter 9 Volume XI, 1926

N.A.C.A. Technical Memorandum No 510, Theoretical Investigation of the Effect of Ailerons on the Wing of an Airplane, by C Weiselsberger, from the Report of the Aeronautical Research Institute, Tokyo Imperial University, No 30, *Vol II*, 16, *December*, 1927.

N.A.C A Technical Memorandum No 511 *On the Strength of Box Type Fuselages, by J Mathar, from the* 1928 *yearbook of the Wisseuschaftliche*

N.A.C.A Aircraft Circular No 94, The Blackburn "Bluebird," Mark IV (British) All-Metal Biplane

N A.C.A Aircraft Circular No 95, the Westland IV Commercial Monoplane (British), three "Cirrus III" engines

N.A.C A Technical Note No 303, *Condensed Data on the Aircraft Engines of the World Compiled by C S Fliedner, Bureau of Aeronautics, U.S.N.*

Royal Aeronautical Society, the R101, by Lieut Col V C Richmond

Royal Aeronautical Society, Engine Performance Testing A paper delivered by Wing-Commander G. B Hynes, D S O, R A F

Royal Aeronautical Society, Air-Cooled Engines in Service, by A H R Fedden, Fellow

Royal Aeronautical Society, The Helicogyre, by V Isacco.

N A C A Aircraft Circular No 91 *The De Havilland D H* 75 *"Hawk Moth" (British) Cabin Monoplane*

N A C A Aircraft Circular No 92 *Nieuport-Delage* 640 *(French) Commercial High Wing Monoplane*

N.A.C.A Aircraft Circular No. 93 Morane-Saulnier 180 *Light Airplane (French) A single seat training plane.*

N.A.C.A Technical Memorandum No 503, *Effect of Stressed Covering on Strength of Internal Girders of a Wing, by H Tellers From the* 1928 *yearbook of the Wissenschaftliche Gesellschaft fur Luftfahrt*

N.A.C.A Technical Memorandum No 501, *Effect of Intake Pipe on the Volumetric Efficiency of an Internal Combustion Engine, by Antonia Capetti From Analli della R Scuola d' Ingegneria di Padova*

TECHNICAL REVIEWS

N A C.A Technical Report No 299, Investigation of Damping Liquids for Aircraft Instruments, by G H Keulegan

This report covers the results of an investigation carried on at the Bureau of Standards with the financial assistance of the National Advisory Committee for Aeronautics.

The choice of a damping liquid for aircraft instruments is difficult owing to the range of temperature at which aircraft operate. Temperature changes affect the viscosity tremendously. The investigation was undertaken with the object of finding liquids of various viscosities otherwise suitable which had a minimum change in viscosity with temperature. The new data relate largely to solutions.

The apparatus consisted of four capillary-tube viscometers, which were immersed in a liquid bath in order to secure temperature control. The method of calibration and the related experimental data are presented in detail.

The viscosity data for the liquids are given in curves in which $\log_{10} \frac{t\theta}{t_{30}}$ is plotted against temperature, where t_{30} and $t\theta$ are respectively the times of discharge through the viscometer at 30 deg C and θ deg C. Except for a correction which is usually small, the following relation holds:

$$\log_{10} \frac{t\theta}{t_{30}} = \log_{10} \frac{v\theta}{v_{30}}$$

in which the v_{30} and $v\theta$ are respectively the kinematic viscosities at 30 deg C and θ deg C. The density at 30 deg C., the coefficient of cubical thermal expansion for each solution, and v_{30} are given, together with other data, so that the absolute viscosity may be computed. The accuracy is within 1 per cent.

N A C A Technical Report No 303, an Investigation of the Use of Discharge Valves and an Intake Control for Improving the Performance of N A C.A Roots Type Supercharger, by Oscar W Schey and Ernest E Wilson

This report presents the results of an analytical investigation on the practicability of using mechanically operated discharge valves in conjunction with a manually operated intake control for improving the performance of N A C.A Roots type superchargers. The investigation was conducted by the staff of the National Advisory Committee for Aeronautics at Langley Field, Va.

These valves, which may be either of the oscillating or rotating type, are placed in the discharge opening of the supercharger and are so shaped and synchronized with the supercharger impellers that they do not open until the air has been compressed to the delivery pressure. The intake control limits the quantity of air compressed to engine requirements by permitting the excess air to escape from the compression chamber before compression begins.

The percentage power saving and the actual horsepower saved were computed for altitudes from 0 to 20 000 ft. These computations are based on the pressure-volume cards for the conventional and the modified Roots type superchargers and on the results of laboratory tests of the conventional type.

The use of discharge valves shows a power saving of approximately 26 per cent at a critical altitude of 20,000 ft. In addition these valves reduce the amplitude of the discharge pulsations and increase the volumetric efficiency. With slow-speed Roots blowers operating at high-pressure differences even better results would be expected. For aircraft engine superchargers operating at high speeds these discharge valves increase the performance as above, but have the disadvantages of increasing the weight and of adding a high-speed mechanism to a simple machine.

N A C A Technical Report No 301 Full Scale Tests of Wood Propellers on a VE-7 Airplane in the Propeller Research Tunnel By Fred E Weick

The investigation described in this report was made primarily to afford a comparison between propeller tests in the new Propeller Research Tunnel and flight tests and small model tests on propellers. Three wood propellers which had been previously tested in flight on a VE-7 airplane, and of which models had also been tested in a wind tunnel, were tested again on a VE-7 airplane in the Propeller Research Tunnel. The results of these tests are in fair agreement with those of the flight and model tests.

Tests were also made with the tail surfaces removed and with both the wings and tail surfaces removed. It was found that the effect of the tail surfaces on the propeller characteristics was negligible, but that the wings reduced the maximum propulsive efficiency about 5 per cent.

N.A.C.A Technical Report No 304, An Investigation of the Aerodynamic Characteristics of an Airplane Equipped with Several Different Sets of Wings, by J W. Crowley, Jr., and M W Green

This investigation was conducted by the National Advisory Committee for Aeronautics at Langley Field, Virginia, at the request of the Army Air Corps, for the purpose of comparing the full scale lift and drag characteristics of an airplane equipped with several sets of wings of commonly used airfoil sections. A Sperry Messenger airplane with wings of R A F-15, U S A-5, U S A-27, and Göttingen 387 airfoil sections was flown and the lift and drag characteristics of the airplane with each set of wings were determined by means of glide tests. The results are presented in tabular and curve form.

A C I C Information Circular No 2916, Determination of the Rates of Descent of a Falling Man and of a Parachute Test Weight

A C I C Information Circular No 2860 Full Scale Tests of the Semi Rigid Airship RS-1, by Lieut Robert E Robillard, A C and Roy A Miller

Royal Aeronautical Society, The Flutter of Aeroplane Wings A paper delivered by R A Frazer, B A, B Sc, A F R Ae S

The High Altitude Airplane

The Concluding Article Discussing Engineering Problems in the Design of an Airplane to Navigate in the Stratosphere

By B. V. Korvin-Kroukovsky

So far we have investigated the power plant only from the point of view of delivery of full power at all altitudes. Now we will consider the cooling point of view. About one-third of the heat value of the fuel burned in the cylinders of an engine is to be transmitted to the cooling water, or to the fins of an air-cooled cylinder, and eventually is to be dissipated in the surrounding air. The rate of heat dissipation is a very important factor in the operation of an engine, as the excessive rise of cylinder temperature immediately brings about detonation, with the resulting loss of power, and possibility of mechanical damage. In a water-cooled engine the temperature of the water must remain well below 212 deg. F. at sea level, and is usually maintained between 160 deg. and 180 deg. F. In air-cooled engines the maximum temperature of the cylinder head should not exceed 600 deg. F. for continuous operation[8]. Dissipation of the heat depends on the difference between the cylinder or radiator and the air temperature, on the velocity of the cooling air, and on its pressure. All these conditions change with altitude; the lower temperature at high altitudes improves cooling, as also does the increased air speed. The reduction of pressure of the cooling air, i.e., the reduction of weight of the air passing through the radiator or through the fins of an air cooled cylinder, impairs the cooling, overbalancing the gains made by the lower temperature and the higher velocity.

It has been shown[9] that the amount of heat transferred from a cylinder to the air stream, in which it is located, can be expressed by the formula

$$W_c = K\,L\,D^{1/2}\,p^{1/2}\,V^{1/2}\,\Delta t/T^{0.133}$$

where

- W_c = the amount of heat transferred in a unit of time
- K = a numerical coefficient
- L = length of the cylinder
- D = diameter of the cylinder
- p = absolute static pressure of the air.
- V = air velocity
- Δt = temperature difference between the cylinder wall and the air stream
- T = average absolute temperature of the surface and ambient air.

The amount of heat to be dissipated depends on the power developed in the cylinder, and for the turbo-superchareged engine remains the same at all altitudes. Moreover we are not interested in the absolute value of the rate of heat transfr, but only in the ratio of this rate at a given altitude to that at sea level, for the same cylinder, i.e., for the same values of L and D. Denoting by p_o, V_o, Δt_o and T_o the values of these quantities at sea level, we can write:

$$(18)\qquad \left(\frac{p}{p_o}\right)^{1/2}\left(\frac{V}{V_o}\right)^{1/2}\frac{\Delta t}{\Delta t_o}\left(\frac{T_o}{T}\right)^{0.133} = 1$$

As we are considering in this paper flight at a fixed angle of attack, with the speed increasing as the density decreases, we can write

$$\frac{V}{V_o} = \left(\frac{p_o}{p}\right)^{1/2} = \left(\frac{p_o}{p}\right)^{1/2}\left(\frac{T}{T_o}\right)^{1/2}$$

substituting this into equation (18) we get

$$\left(\frac{p}{p_o}\right)^{1/4}\left(\frac{T}{T_o}\right)^{0.127}\frac{\Delta t}{\Delta t_o} = 1$$

for the range of temperatures with which we are concerned the factor $(T/T_o)^{0.127}$ does not deviate from unity by more than three per cent, and therefore can be neglected. Thus we can write finally

$$(19)\qquad \frac{\Delta t}{\Delta t_o} = \left(\frac{p_o}{p}\right)^{1/4}$$

Before proceeding with comments on what this expression shows in regard to high altitude flying, we will

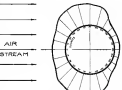

Fig 6—A diagram showing the distribution of cooling intensity around an air cooled engine cylinder

stop to check it against such flight data as available. In the preliminary flight tests of a UO-1 airplane[10] with Wright Whirlwind engine, equipped with the engine-driven Roots type supercharger, the temperature of all cylinders was measured at points on the cylinder heads just back of the front spark plugs. The temperature varied somewhat for different cylinders, but the average temperature was about 415 deg. F. at ground level, and 465 deg. F. at the altitude of 20,000 ft. The air temperatures were respectively 75 deg. F. and 10 deg. F. Thus we have from actual observation the ratio

$$\frac{\Delta t}{\Delta t_o} = \frac{465 - 10}{415 - 75} = 1.34$$

In applying the theoretical formula we must remember that in the case of an engine-driven supercharger with exhaust open to reduced air pressure, the power developed in the cylinders and therefore the heat dissipated, is not constant, but increases at the rate of 1.3 per cent per pound of pressure difference between the intake and the exhaust. For this case then expression (19) has to be rewritten as:

$$(20)\qquad \frac{\Delta t}{\Delta t_o} = [1 + 0.013\,(p_o - p)]\left(\frac{p_o}{p}\right)^{1/4}$$

at the altitude of 20,000 ft we have:

$$p_o/p = 2.18$$
$$p = 14.7/2.18 = 6.75 \text{ lb/sq.in.}$$
$$p_o - p = 7.95$$

hence:

$$\frac{\Delta t}{\Delta t_o} = 1.103 \times 2.18^{1/4} = 1.34$$

The agreement between theoretical estimate and the result of the test observation is remarkable, and apparently we can rely on expression (19) to give correct values for the turbo-supercharged air-cooled engine.

Assuming expression (19) to be correct, let us consider now what will happen at a high altitude, say 75,000 ft. The ratio of temperature differences between the cylinder wall and the air at that altitude and at ground level will be

$$\frac{\Delta t}{\Delta t_o} = \left(\frac{p_o}{p}\right)^{1/4} = 29.2^{1/4} = 2.32$$

We have stated that maximum permissible temperature of the cylinder is 600 deg. F. The temperature of

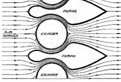

Fig 7—The suggested type of fairing to direct the air flow around an air cooled engine cylinder

the air in the stratosphere is —73 deg. F., hence the maximum permissible temperature difference is 673 deg. F. In order to obtain such a temperature difference at the altitude of 75,000 ft., the temperature difference at ground level should be

$$\Delta t_o = 673/2.32 = 290 \text{ deg. F.}$$

As the actual temperature difference observed on the Wright Whirlwind engine installed in the Vought UO-1[10] was 340 deg. F., it is evident that the cooling efficiency of the installation should be increased at least 15 per cent. This is a comparatively small increase, which can be obtained in a number of different ways. It has been found[10] that installation of the oil radiator alone reduced the temperature of the cylinder head by 45 deg. F., or about 13 per cent of the average temperature difference. The reduction of the temperature of incoming mixture by the use of efficient intercoolers between the supercharger and the cylinders, is another powerful method of reducing compression temperatures, and keeping them below the detonation point.[11]

As a matter of fact cooling of air-cooled engines has been accomplished up to the present time in a rather haphazard way, by merely letting the cylinders project into the air stream, and there is plenty of room for improvement in this field. The latest type of cowling completely enclosing the engine, as it was recently tested by the N.A.C.A., carries the promise of more efficient cooling at the same time reducing the air resistance. This type of cowling, for instance can be supplemented by a fan, increasing the velocity of the air at the cylinders and thus supplying the additional cooling needed for the high altitude work. Merely exposing the round cylinder to the air stream is not a very efficient way of cooling. The theoretical calculation, as well as the wind tunnel tests, show that air velocity on the front side of the cylinder is fairly low, reaches its maximum value on the sides, and rapidly diminishes towards the rear, where the mass of the turbulent air following the cylinder is found. Actual measurements of heat flow were made on the cylinder of an air-cooled engine[12] and showed that rate of cooling follows the same law. The results of these measurements are shown in Fig. 6. It is quite probable that cooling could be materially improved by fitting some spacers between the cylinders, such as shown in Fig. 7, which would make the air flow around the cylinder at a fairly uniform velocity, maintaining this velocity well in the rear. The lack of turbulence and of resultant resistance will increase the velocity of the air flow, while the uniformity of velocity will cause uniform cooling, with large increase of the total cooling capacity.

The last important part of the power plant, liable to cause trouble at a high altitude, is the propeller. The efficiency of the propeller depends mostly on the relation between its pitch and diameter, and these in turn depend on the engine power, on the propeller r.p.m., on the speed of flight and on the density of the air. We have here four variables, all of which depend on altitude. The airplane capable of flying at all altitudes up to some 80,000 ft., will operate in air varying some 25 times in density, yet its propeller must be capable of transforming the engine power into the tractive power at all times. Fortunately, the propeller has been made the subject of intensive theoretical and experimental research from the first days of flying up to the present time, and sufficient information is available for the design of a propeller even for such an odd machine as a high altitude airplane. It has been found that aeredynamic properties of a propeller of any given shape can be completely described by three mutually dependent coefficients: V/ND, C and η. The first of these coefficients, the ratio V/ND is usually

[8] D. Heron—S.A.E. Journal, January 1923.
[9] Chester W. Rice "Forced Convection of Heat in Gases and Liquids," Industrial and Engineering Chemistry May 1924.
[10] N.A.C.A. Report No. 283.

[10] N.A.C.A. Report No. 282.
[11] S.A.E. Transactions Vol. 21, Part 1, Page 278.
[12] M. Schenk "Probleme des Höhenflugs" Zeitschrift für Flugtechnik und Motorluftschiffahrt 12 Jahrg. 1928.

taken as the independent variable, and the other two are expressed as its functions. Here:

V denotes the speed of flight in ft. per sec.

N denotes propeller revolutions per second.

D denotes propeller diameter in ft.

The second coefficient C is known as the power coefficient, and is determined by equation:

$$(21) \qquad P = C\rho V^5 N^{-2}$$

where

P is the engine power in ft.-lb. per sec.

ρ is the air density in slugs per cu. ft., or density in lb. per cu. ft. divided by the acceleration of gravity.

The coefficient C depends only on the shape of the propeller (not on its size) and on the value of the ratio V/ND. As long as this ratio remains constant, the coefficient C remains constant, no matter how small or how large the propeller.

The third coefficient η is the propeller efficiency, which also depends only on the value of V/ND and on the shape of the propeller, but not on its size. When the propeller or its model is tested in a wind tunnel, the values of C and η are determined and are plotted against V/ND. A large number of different propellers were thus tested by Dr. W. F. Durand in the Leland Stanford, Jr., University, and the results of these tests were published by the N.A.C.A. Fig. 8 was plotted from the data given in one of these reports,[18] and shows the variation of the coefficient C with variation of the ratio V/ND for variable pitch propeller No. 96. This propeller was originally designed for the pitch to diameter ratio of 0.7, and then had its blades adjusted from —6 deg. to + (larger pitch) 20 deg. The maximum values of efficiency η, are marked on the curves for different blade settings, and the dotted line drawn through the points of maximum efficiency shows variation of the coefficient C vs. V/ND when the blade angle is kept adjusted to maximum efficiency at all speeds.

Let us consider first the propeller with fixed blades, and let us assume that the coefficient V/ND remains the same at all altitudes. We will denote by P, C, ρ, V and N, the power, power coefficient, the density of the air, the air speed and the r.p.m. at any altitude, and by P_o, C_o, ρ_o, V_o and N_o the initial value of these quantities at sea level. Then making use of expression (21), we will write the ratio of the power absorbed by the propeller at any altitude to the power absorbed at sea level as:

$$(22) \qquad \frac{P}{P_o} = \frac{C}{C_o}\frac{\rho}{\rho_o}\left(\frac{V}{V_o}\right)^5\left(\frac{N_o}{N}\right)^2$$

The propeller diameter D remains, of course, the same at all altitudes, and from the assumption of

$$V/ND = V_o/N_oD = Const.$$

it follows that

$$(23) \qquad \frac{N_o}{N} = \frac{V_o}{V} = \left(\frac{\rho}{\rho_o}\right)^{1/2}$$

If V/ND remains constant, the power coefficient C also remains constant, and the ratio C/C_o is equal to one.

[18] N.A.C.A. Technical Report No. 141.

Taking note of this fact and substituting (23) into (22) we get:

$$\frac{P}{P_o} = \frac{\rho}{\rho_o}\left(\frac{\rho_o}{\rho}\right)^{5/2}\frac{\rho}{\rho_o} = \left(\frac{\rho_o}{\rho}\right)^{1/2}$$

or by comparison with (23) we obtain finally

$$(24) \qquad \frac{P}{P_o} = \frac{N}{N_o} = \frac{V}{V_o} = \left(\frac{\rho_o}{\rho}\right)^{1/2}$$

The first two members of this equation express the fact that, as the airplane climbs, the engine horsepower remains proportional to the r.p.m., which is quite true for a supercharged engine with exhaust-gas-driven supercharger to a certain maximum value of r.p.m. The first, third and last members are identical with expression (6) for the power required for horizontal flight at any altitude, derived at the beginning of this article. It follows from equation (24) that *power delivered by an engine equipped with exhaust-gas-driven supercharger and with fixed blade propeller remains proportional to the power required for flight at any altitude as long as the engine power remains proportional to r.p.m.*

The propeller fitted must be large enough to hold the engine to very low r.p.m. at sea level, say to 400, in

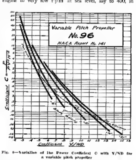

Fig. 8—Variation of the Power Coefficient C with V/ND for a variable pitch propeller

which case there will be a certain small excess of power available over power required for horizontal flight. Let us assume that this excess which can be utilized for the climb is 20 per cent of the power available. As the airplane climbs and the air density decreases, the air speed, engine r.p.m., power available and power required increase in the same proportion, but the excess power has the same relative value of 20 per cent. The actual excess horsepower will increase and *the rate of climb will increase with altitude in inverse proportion to the square root of the air density*. At the altitude of about 68,000 ft., where the ratio ρ_o/ρ is equal to 16, the air speed will be increased four times, and the engine will reach its normal r.p.m. of 1,600 and its normal horsepower. With

further climb and increase in r.p.m. the engine torque will begin to diminish, the power no longer will be proportional to r.p.m. and equation (24) will no longer hold. Thus the *ceiling of an airplane equipped with a fixed blade propeller will be determined by the engine speed at which the power ceases to be proportional to r.p.m.* The necessarily drastic reduction of the r.p.m. at low altitude is a very important drawback of the fixed blade propeller on a high altitude airplane. While the engine is capable of delivering some four times the power needed for horizontal flight at sea level, the propeller holds it to such a low r.p.m. that available excess power is small, and climb, therefore, is very slow. Any increase of the engine r.p.m. and of the rate of climb at sea level by a corresponding design of the propeller will make it reach its maximum r.p.m. at the lower value of the ratio ρ_o/ρ, and will result therefore in a lower ceiling.

In the case of a variable pitch propeller the engine r.p.m. can be varied at will of the pilot by varying the propeller pitch, with throttle left wide open. In investigation of such a propeller we must therefore assume some arbitrary rule for the variation of the r.p.m. with altitude or density. Let us assume the variation according to the following general law:

$$(25) \qquad \frac{P_o}{P} = \frac{N_o}{N} = \left(\frac{\rho_o}{\rho}\right)^n$$

where we can assign to n any arbitrary value. As the coefficient V/ND varies in this case, the coefficient C will also vary. On the bases of equation (21) we can write:

$$\frac{C_o}{C} = \frac{\rho}{\rho_o}\frac{P_o}{P}\left(\frac{V}{V_o}\right)^5\left(\frac{N_o}{N}\right)^2$$

or substituting (25) and

$$\frac{V}{V_o} = \left(\frac{\rho_o}{\rho}\right)^{1/2}$$

we get

$$(26) \qquad \frac{C_o}{C} = \frac{\rho}{\rho_o}\left(\frac{\rho_o}{\rho}\right)^n\left(\frac{\rho_o}{\rho}\right)^{5/2}\left(\frac{\rho_o}{\rho}\right)^{2n} = \left(\frac{\rho_o}{\rho}\right)^{3n+1.5}$$

Now, in the ideal case, we want the r.p.m. to remain constant, and the engine to deliver its full power at all altitudes, i.e., we want n to be equal to zero, as

$$\frac{N_o}{N} = \left(\frac{\rho_o}{\rho}\right)^0 = 1 = Const.$$

substituting $n = O$ in equation (26) we get:

$$\frac{C_o}{C} = \left(\frac{\rho_o}{\rho}\right)^{3/2}$$

In the altitude of 68,000 ft., for instance, we would obtain the following relations:

$$\begin{aligned} \rho_o/\rho &= 16 \\ V/V_o &= 16^{1/2} = 4 \\ (V/ND)/(V_o/N_oD) &= 4 \\ C_o/C &= 16^{3/2} = 64 \end{aligned}$$

The examination of Fig. 8 shows that variation of 64 times in the value of coefficient C is not consistent with variation of four times in the value of the coefficient V/ND. Let us assume that at the highest altitude and maximum speed we have the value of $V/ND = 1.25$. Then with propeller blades adjusted to +20 deg. we will have the coefficient $c = 0.06$, with the propeller working at its best efficiency. At the ground level we will have the value of $V/ND = 1.25/4 = 0.31$, and we want to have the value of $c = 0.06 \times 64 = 3.84$, while the least value we read on the curves is 18 for the propeller blades set at —6 deg. Such a large discrepancy between the desired and the actual figures shows the impossibility of the original assumption, and we conclude that *even with adjustable pitch propeller it will be hardly possible to maintain constant r.p.m. and constant engine power at all altitudes.*

Finding it impossible to maintain constant engine r.p.m., we can investigate now the case of varying the pitch so as to allow a certain reduction of r.p.m. at low level, but not such a drastic one as in the case of a fixed pitch propeller. For the fixed pitch propeller we had $n = -\frac{1}{2}$, for the variable pitch one we found that the case of $n = 0$ is impossible. Let us now assume for n the intermediate value of $-\frac{3}{8}$. Substituting $n = -\frac{3}{8}$ in (26) we get

$$\frac{C_o}{C} = \left(\frac{\rho_o}{\rho}\right)^{3/8}$$

or assuming the same altitude as before, we obtain the following relations.

$$\begin{aligned} \rho_o/\rho &= 16 \\ V/V_o &= 16^{1/2} = 4 \\ N/N_o &= 16^{3/8} = 2.82 \\ (V/ND)/(V_o/N_oD) &= 1.41 \\ C_o/C &= 2.82 \end{aligned}$$

If we get at high speed, with propeller blades set at +20 deg., the values corresponding to the best efficiency

$$\begin{aligned} V/ND &= 1.25 \\ C &= 0.06 \end{aligned}$$

we will have at ground level

$$\begin{aligned} V_o/N_oD &= 1.25/1.41 = 0.89 \\ C &= 0.06 \times 2.82 = 0.17 \end{aligned}$$

Examination of the curves of Fig. 9 shows that point ($V/ND = 0.89$, $C = 0.17$) falls right on the curve of +8 deg. blade setting at its maximum efficiency. This shows that assumed variation of the r.p.m. with the density is satisfactory, and that even with the variable pitch propeller we have to admit considerable reduction of the r.p.m. at low altitude. We have found before that, assuming the engine to give 1,600 r.p.m. as maximum at the altitude of 68,000 ft., where the ratio $\rho_o/\rho = 16$, we get at ground level 1,600/4 = 400 r.p.m. for the fixed pitch propeller, and 1,600/2.82 = 568 r.p.m. for the variable pitch propeller. Even with this reduction of r.p.m., the power delivered by the variable pitch propeller at ground level will be 50 per cent larger than power delivered by a fixed pitch propeller, and much quicker climb can be obtained without sacrifice in the ceiling.

It will be observed that in order to obtain these results the blade setting had to be varied very little—from +8 deg. to +20 deg., and that much better efficiency can be obtained than that shown in Fig. 8. The propeller represented by Fig. 8 has very wide variation of blade settings, and its blades were designed for rather low pitch of 0.7. Its efficiency therefore is much lower than can be expected for a high altitude airplane.

In the above discussion we often mentioned the maximum propeller speed of 1,600 r.p.m., which may appear very low to the reader, as modern aircraft engines are often operated at more than 2,000 r.p.m. These high-speed engines are used at present in airplanes flying at

moderate altitude, where the air density permits use of propellers of a small diameter, so that stresses in blades are kept within reasonable limits, and the tip speed does not exceed the velocity of sound. The rarefied air at such a high altitude as 70,000 ft., however, requires a propeller of much larger diameter, and were the same high r.p.m. used, the stresses in blades would become excessive. The tip speed at the same r.p.m. would increase in proportion to the diameter, while the allowable speed, which is slightly below velocity of sound, would decrease, as the velocity of sound decreases with altitude. At sea level the velocity of sound is 1,110 ft. per sec., while at the altitude of 36,000 ft. it is only about 970 ft. per sec.[14] The necessity of reducing the tip speed leads us to the use of geared engines, and requires the employment of all means for reducing the propeller diameter, such as use of the four-bladed propellers, and of wide blades. It may be noted that at the large value of pitch to diameter ratio, necessitated by the high speed of an airplane at a great altitude, this means will have no appreciable effect on the propeller efficiency. To give the reader a more concrete idea of the propeller size, we can mention that to absorb 400 hp. at 1,600 r.p.m. at the altitude of 68,000 ft. ($\rho_0/\rho = 16$) and at the air speed of 280 m.p.h., the two-bladed propeller must have a diameter of 15 ft., and four-bladed propeller must have a diameter of about 13 ft., using the ordinary blade width and shape. The coefficient V/ND for the four-bladed propeller would have a value of about 1.2, and the pitch diameter ratio would be about 1.3.

Summarizing all said above about the propeller for the high altitude airplane we can say:

1. It is quite possible to use a fixed pitch propeller, and if used it will operate at a constant value of the ratio V/ND and will give very high efficiency at all altitudes. The propeller r.p.m. and engine power will be proportional to the air speed, and the percentage of reserve power available for climb will remain the same at all altitudes. As this percentage cannot be made large, without impairing the ceiling and the maximum speed, the climb will be necessarily slow.
2. Even the use of a variable pitch propeller probably will not permit keeping constant r.p.m. and full engine power at low altitudes. Moreover, the attempt to design a propeller for this purpose will result in a poor shape of blades and in a greatly reduced efficiency at maximum altitude.
3. Such a use of a variable pitch propeller as to allow a certain reduction of r.p.m. at low altitudes, but not one as drastic as in case of a fixed pitch propeller, probably can be considered as the best solution. Varying the r.p.m. with constant engine torque according to the law

$$\frac{N}{N_0} = \left(\frac{\rho_0}{\rho}\right)^{3/8}$$

results in the propeller working at its best efficiency at any altitude, gives a narrow range of pitch variation not detrimental to the maximum efficiency, and increases the available power at ground level by about 50 per cent as compared to a fixed pitch propeller.
4. In view of the large bending and centrifugal stresses generated in the blades of propellers of large diameter, and also in view of keeping the tip speed from exceeding the velocity of sound which diminishes with altitude, it will be necessary to use four-bladed propellers, with wide blades, and to use geared, or very low-speed engines.

In the preceding paragraphs we considered the action of the power plant at a high altitude from the points of view of maintenance of full power, proper cooling, and of the action of the propeller. We have shown that the equipment available at present: the engine, the supercharger and the propeller, can be easily adapted for work at a very high altitude, and that flying at such an altitude is technically possible. Now we will have to consider the accommodations which will have to be provided in order to enable the human beings to live and act when the surrounding atmosphere has the pressure of some 1/30 of the pressure at the ground, and the temperature is 67 deg. F. below zero. The human beings depend for their life on the oxygen of the air, which is absorbed by the haemoglobin of the blood in the lungs, and is carried by it to all parts of the body. To a certain extent this process is independent of the atmospheric pressure, and men can live at reduced pressure, provided they are supplied with the necessary amount of oxygen. This applies, however, only to a pressure not less than about one-half of the normal atmospheric pressure, or to an altitude not exceeding 20,000 ft. From this pressure on, the capacity of the haemoglobin to absorb the oxygen is not appreciably affected by the pressure, but as the pressure is reduced to 347 mm. of mercury the haemoglobin begins to give out oxygen, and at lower pressures its capacity to hold oxygen is considerably reduced.[15] It is a well-known fact that on almost all altitude record flights the pilots suffered distress, and often lost consciousness, notwithstanding the supply of oxygen which they carried. It is necessary therefore that an airplane designed to operate at an atmospheric pressure of 1/30 of the normal, be equipped with an air tight cabin, the air pressure inside of which will be maintained at not less than half of the normal ground pressure, and preferably at a normal pressure of 760 mm. of mercury. At first sight it may appear that this would result in excessive weight of the fuselage, but this is not the case, as we shall now demonstrate.

We are faced with the problem of designing a cabin inside of which there is a pressure of 14.7 lb. per sq.in. and outside of which we can assume an absolute vacuum, in order to be on the safe side. Evidently the cabin must be made circular in cross section, like a steam boiler, because in such a case the walls are subjected only to tensile stress, and not to bending as would be the case with a flat wall of a rectangular container. The thickness of the wall of a cylindrical container subjected to an inside pressure can be determined by the formula:

$$t = K\,\frac{pd}{2kf} \tag{27}$$

where

t—is the thickness of wall in inches
p—the difference in the pressure inside and outside of the container in pounds per square inch
d—inside diameter in inches
f—tensile strength of the material used for walls
K—factor of safety
k—efficiency of the riveted joints

We can assume for a five seater 425 hp. airplane the

[14] N.A.C.A. Technical Memorandum No. 412.

[15] Transactions of the Institution of Chemical Engineers (British) Vol. 1 1923.

diameter of the fuselage of six feet or 72 in., the fuselage to be constructed of sheet duralumin of tensile strength $f = 55{,}000$ lb. per sq.in. The efficiency of triple row riveted joints can be assumed at 80 per cent, and a factor of safety of four will be ample. Substituting these figures in equation (27) we get

$$t = 4 \times \frac{14.7 \times 72}{2 \times 0.80 \times 55{,}000}$$

i.e., a fuselage constructed of No. 18 (0.049) B. & S. gauge duralumin will have ample strength to withstand the required pressure. Incidentally this is the gauge one would naturally choose from experience for construction of a metal monocoque fuselage for a machine of such size, whether for high altitude work or not, and experience also shows that monocoque fuselages are usually found to be just as light as steel tube ones, and often lighter.

The question of heating the cabin is evidently an elementary one, as there are many materials of light weight and high insulating value which can be used for lining the cabin. The air for the use of the crew will have to be compressed, and fed into the cabin by means of a small compressor, probably of centrifugal type, as freedom from lubricating oil and the purity of the air will be essential. The problem of designing and building such a compressor is not different from that of the engine supercharger, but is much simpler on account of the small size. A man requires about 300 cu.ft. of fresh air per hour, which would make 1,800 ft. for six men, as compared to about 42,500 cu.ft. per hour consumed by the 425 hp. engine. The power required to compress this small amount of air can be further reduced by letting the used air escape through an air turbine which would drive the compressor. The windmill mounted on the common shaft with the turbine and compressor will make up for the loss of power in this cycle of compressing and expanding the same volume of air. This small turbocompressor therefore will depend for its operation only on the speed of the airplane and will be entirely independent of the power plant.

At the beginning of this article we demonstrated the gain in speed which will be made possible by high altitude flying, and we came to the conclusion that in the present state of aeronautical engineering a gain of 50 per cent is probable. We pointed out that there are many other advantages, besides the high speed of the machine, but we postponed the discussion of these until we proved the possibility of high altitude flying considering the engineering means at our disposal. Having proved this we can now discuss the other advantages. All these advantages are brought about not by the machine itself but by the surroundings in which it operates, i.e., by the properties of the atmosphere, which we will briefly outline here.

The atmosphere is usually considered as divided in two distinct parts: *the troposphere* and the *stratosphere*. *The troposphere* is the lower part of the atmosphere, up to from 30,000 to 45,000 ft., depending on the time of year and on the latitude. It is shallowest in the Winter and in high latitudes, and is highest in Summer and at the equator. Its characteristic property is the abundance of up and down convection currents, and the temperature falling continuously with the altitude from some +60 deg. F. at the ground to some 67 deg. F. below zero at its upper limit. Comparatively warm air at its lower levels holds large amount of moisture, which condenses when convection currents carry it to the higher and cooler levels, forming clouds and precipitating rain and snow. The lower levels of the troposphere are heated by contact with the earth, and the heating not being uniform, violent convection currents occur giving rise to storms and occasionally tornadoes.

The stratosphere is the upper part of the atmosphere extending from the upper limit of the troposphere. Its characteristic property is the lack of up and down currents, and approximately uniform temperature averaging 67 deg. F. below zero. On account of the very low temperature the air is very dry, and the lack of convection currents, as well as the uniformity of temperature, result in the complete absence of clouds. The wind velocity may be high but it is very uniform, and is governed by general dynamic laws resulting from the rotation of the earth, and not by accidental causes which make weather variations so uncertain in the troposphere, near the ground.

From the general outline of the structure of the atmosphere it can be seen that flying at a low altitude in the troposphere can be compared to navigation on a stormy sea, while high altitude flying in the stratosphere resembles navigation on a calm lake. Because of the time required for the climb and for descent, and because of the high speed attainable, high altitude flying is more suitable for long distance operation, and its advantages can be most forcibly stated in comparison with the difficulties experienced by the transoceanic flyers of 1927 and 1928. These difficulties can be classified under four general headings as follows:

1—*Contrary Winds* causing the exhaustion of the fuel supply and premature landing.

2—*Hardships and perils* caused by storms, electric storms, fog, rain, snow, and, most dangerous of all, sleet.

3—*Difficulties of navigation* when the overcast sky prevented astronomical navigation, varying winds made dead reckoning unreliable, and roughness of air made all observations difficult and inaccurate.

4—*Forced landings* made suddenly necessary by engine failure.

The first of these difficulties—unexpected contrary winds will be entirely eliminated in high altitude flying, because the winds in the stratosphere do not vary as quickly and as often as they do at low altitude. Being governed by general laws, rather than by the whim of accidents, they will be easily charted and allowed for in making the flying schedules. Moreover, they probably will be used advantageously to speed the flying schedule, by flying higher or lower, depending on the location of the strata of tail wind. Indeed, we will remember that live interest towards high altitude flying, and the appreciation of its possibilities for long distance transportation in this country dates from the early altitude flights of Major Schroeder, who observed the strong westerly wind at a high altitude. Our knowledge in regards to the winds in the stratosphere is limited, but there exists some information obtained by means of sounding balloons which shows that there exist several layers of different wind direction and velocity. The observations made at

a station near the equator showed the following distribution of winds[16]

From 0 to about 15,000 ft—NE "Trade Winds"
From 15,000 to about 45,000 ft—SW Counter Trades
From 45,000 to about 60,000 ft—Upper Easterly
From 60,000 to about 75,000 ft.—Upper Westerly
From 75,000 to about 90,000 ft—Easterly

The velocity of the wind was observed to increase with altitude to reach a maximum of about 60 m p h at the base of the stratosphere, and then to diminish rapidly. An airplane capable of climbing to an altitude of some 75,000 ft. will probably choose the altitude of about 45,000 ft on Eastward flights, thus adding about 60 m p h to its own speed, while the airplane flying westward will fly at an altitude of approximately 60,000 ft, taking advantage of the upper Easterly wind. The ability to choose favorable winds, and the steadiness of these winds combined with naturally high speed of the high altitude airplane will double the speed as compared to the speed possible on scheduled flights at low altitude

The second difficulty storms, rain, snow and sleet—is inseparably connected with the troposphere, and is absent in the stratosphere, where there are no clouds and practically no moisture

The difficulties of navigation are caused essentially by the cloudiness and by uncertainty of winds. The absence of clouds in the stratosphere will make astronomical navigation possible at any time of the day or night, while the steadiness and the permanency of the wind structure will make even dead reckoning accurate. Freedom from convection currents and from gustiness will make it unnecessary to control the airplane continuously, as in absence of disturbances the airplane with normal degree of stability will fly by itself indefinitely. The pilot relieved from the necessity of continuous control will be able to devote his time to navigation and to radio communication, thus eliminating the need of a special navigator and radio operator[14]. It is probable that at the altitude of 75,000 ft where 97 per cent of the air and practically all of the moisture and dust are below, and only 3 per cent of clear air is above the sky will appear almost black, and stars will be visible in broad daylight, allowing considerable simplification of navigation.

The effect of high altitude on safety in case of forced landing is not evident, but is nevertheless very important. We will recall that airplanes flying low have to land within a few seconds after failure of the engine, and in the case of transoceanic flights usually were destroyed. In cases when the nature of the trouble allowed them to fly long enough to land near a steamship, they were usually saved. Now, the airplane flying at the altitude of 70,000 ft, and possessing a gliding angle of one to eleven can land anywhere within a circle of some 300 mi in diameter. Its initial air speed of about 212 m p h at that altitude will diminish to some 60 m p h at sea level, the average speed being about 135 m p h, and the time required for the descent will be in excess of one hour. This time will enable the pilot to get in touch by radio with a steamship, as one probably can be found within such a large area, to get information about its position and to land alongside of it. The very type of rugged monocoque fuselage designed to hold air at a great altitude will enable it to float for a long time in comparative safety

[16] McAdie "The Principles of Aerography," page 193

PATENTS ISSUED

Patent No 1,709,220—Aircraft Frank J Jaeger, Toledo, Ohio Three Claims

Patent No 1,709,402—Aeroplane William Jordan and Charles S Nichols, Lancaster, Nebr One Claim.

Patent No 1,710,028—Aeroplane Herman James Morse, Raymond, Wash One Claim

Patent No 1,710,137—Adjustable Wing for Aeroplanes John C Bankston Shreveport, La One Claim

Patent No 1,710, 225—Aeroplane Aubrey M Kennedy, New York, N Y Two Claims

Patent No 1,710 290—Landing Mechanism for Aeroplanes John Enlow Broyles, Entiat, Wash Three Claims

Patent No 1,710,423—Floating Air Liner Swan M Lindstrand, Chicago, Ill Two Claims.

Patent No 1,710,476—Airplane Randolph F. Hall, Ithaca, N Y. Six Claims

Patent No 1,710,618—Safety Attachment for Aeroplanes Angelo C. Harper, Washington, D C Five Claims.

Patent No 1,710,628—Brake for Aeroplanes John H Kessler, Nyack, N Y Three Claims

Patent No 1,710,670—Aeroplane Leonard W Bonney, Flushing, N Y Flora MacDonald Bonney, executrix of said Leonard W Bonney, deceased Twenty Claims

Patent No. 1,708,994—Metal Spar for Use on Aircraft Hamilton Neil Wylie, Coventry, England, assignor to Sir W G Armstrong Whitworth Aircraft, Ltd, Parkside, Coventry, England Two Claims

Patent No. 1,709,058—Landing Method for Aircraft Frederick Brunner, Camden, N J. Six Claims

Patent No 1,709,069—Launching and Landing Station Julius S. Fox, Cleveland, Ohio. Four Claims

Patent No 1,709,264—Apparatus for Lowering Mail Bags and Other Loads from Aircraft Harold Edward Sherwin Holt, London, England Eight Claims

Patent No. 1,709,377—Beacon System for Night Flying Elmer A Sperry, Brooklyn, N Y assignor to Sperry Development Co, Dover, Del Seventeen Claims

Patent No 1,709,395—Gyroscopic Compass Reginald E Gillmore, Stanford, Conn, assignor, by mesne assignments, to Sperry Gyroscope Co, Brooklyn, N Y Seven Claims.

Patent No 1,709,620—Signaling and Projecting Images of Aerial Craft Hugo Junkers, Dessau, Germany One Claim

Patent No 1,709,621—Method and Means for Navigating Aircraft. Hugo Junkers, Dessau, Germany Six Claims

Patent No 1,709,644—Aircraft Flare Samuel Wiley, Jr, Metuchen, N J Eight Claims

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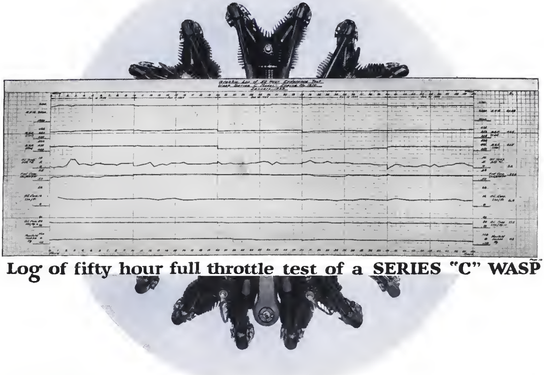

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